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# A GENERIC SYNOPSIS OF THE COCCINELLID LARVAE IN THE UNITED STATES NATIONAL MUSEUM, WITH A DESCRIPTION OF THE LARVA OF HYPERASPIS BINOTATA SAY

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BY

ADAM BÖVING

Of the Bureau of Entomology, United States Department of Agriculture

No. 2171.—From the Proceedings of the United States National Museum,
Vol. 51, pages 621–650, with Plates 118–121

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# A GENERIC SYNOPSIS OF THE COCCINELLID LARVAE IN THE UNITED STATES NATIONAL MUSEUM, WITH A DESCRIPTION OF THE LARVA OF HYPERASPIS BINOTATA SAY.

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## INTRODUCTION.

This paper is a contribution from the Branch of Forest Insects prepared under an arrangement between Dr. A. D. Hopkins, in charge of Forest Insects, and Dr. A. L. Quaintance, in charge of Deciduous Fruit Insects of the Bureau of Entomology, United States Department of Agriculture, to supplement a biological paper by F. L. Simanton, Entomological Assistant, Deciduous Fruit Insects, entitled Hyperaspis binotata, A Predatory Enemy of the Terrapin Scale.[1]

In connection with the author's investigations of Coleopterous larvae affecting forest and shade trees, he has been glad of an opportunity to study in details the morphology of the larva of *Hyperaspis binotata* Say, and to work out a synopsis of the larvae of the Coccinellid genera, represented in the United States National Museum. The systematic notes of the present paper are, however, only intended as an outline for further studies and as a small contribucion in the discussion about the natural arrangement of the genera of this difficult group. The student of the family must rely upon earlier papers, among the most useful of which are L. Ganglbauer's critical abstract in his Die Käfer von Mitteleuropa (vol. 3, 1899), and especially the admirable paper of George Dimmock: Algunas Coccinellidae de Cuba in Primer informe anual de la Estación Central Agronomica de Cuba (1906). As the present synopsis is based on the morphological study of the larva of *Hyperaspis binotata*, the description of this larva has been placed first.

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[1] Journ. Agric. Res., Dept. Agric., Wash., D. C., vol. 6, 1916, pp. 197-203, with two plates.

Proceedings U. S. National Museum, Vol. 51—No 2171.

## GENERAL DESCRIPTION OF THE FULL-GROWN LARVA OF HYPERASPIS BINOTATA SAY.

The full-grown larva is about five millimeters long; oval in outline, strongly arched above, with flattened underside (figs. 1, 2, 3). The head is bent downwards; its posterior edge is covered by the fleshy anterior margin of the prothorax; the color is light greenish gray with the more strongly chitinized parts shiny dark brown, and with a dark brown pattern (as shown in figs. 8, 9, 10); it is rectangular, very broad, with an unusual capacious mouth cavity (fig. 7), capable of containing an entire larva of the *Lecanium*, which constitutes its principal prey. This increase of the mouth has been effected by the enlargement of the labrum and the labium and by the incorporation of the dorsal side of the maxillary stipes into the wall of the mouth (*std*. II, fig. 7); the labrum (fig. 1 and *lr*, figs. 8 and 9) is nearly perpendicular, covering and protecting the approximately horizontal mandibles (*md*, figs. 8 and 9) and the fleshy lobes of the ventral mouth parts (*la*, *li*, figs. 8 and 9). Due to the enlargement of the mouth cavity, the mandibles are so displaced (fig. 7) that they can only meet each other with their very pointed apex (*apx*, fig. 6), while the convex, broad and flattened molarlike bases (*mo*, fig. 6) are widely separated; these molarlike bases can, for that reason, not work against each other, but they work in the corner of the mouth against the concave end surfaces of a hypopharyngeal bridge peculiar to this family (*br*, figs. 7, 9), grinding and squeezing the juices out of the prey; the fleshy lobes of the ventral mouth parts close the mouth and retain the juice during mastication until it can be sucked in and swallowed by the movements of the pharynx (*ph*, figs. 4, 7). These remarkable morphological modifications of the mouth parts have not been recorded before and are probably not found outside the family *Coccinellidae*. There are three large ocelli (fig. 1, *oc*, fig. 8) on each side; the antennae are three-jointed with a tactile filament (*fil*, fig. 8) at the apex of the second joint; the maxillary palpi are normal, three-jointed, with the usual sensory papillae on the terminal joint; labial palpi minute and two-jointed (fig. 8).

The subglobose shape of the body, with the flat ventral side pressed against the supporting surface is similar to that of most of the coleopterous larvae, which live on leaves and twigs, and is well adapted to these surroundings; the color is pale, yellowish gray, somewhat lighter underneath and with small, brown, chitinous spots indicating muscle attachments (*ms*, fig. 1); the body is pubescent, bears well-developed setae, especially on the dorsal and lateral areas, and has numerous small pores in the skin on all segments (*por*, fig. 5); but all these characters are not apparent on the living larva because it is covered by tufts of long, pure white, waxy threads, which are exuded from

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three rows of dorsal depressions on each side of the body. Some of the lateral setae (*cols*, fig. 5) are very large, very fragile, and of a peculiar structure, emitted from a collarlike prolongation of the basal cup. The fragile nature and specialization of these hairs suggest that they are defensive, either in a merely mechanical way or possibly containing a poison. Undoubtedly protective organs are certain large repugnatorial glands, which can emit drops of bloodlike fluid; these are placed dorsally in the intersegmental skin on each side of the first eight abdominal segments (*bg*, figs. 1 and 5). Small ring-shaped light brown spiracles (*sp*, figs. 1 and 5) occur on the mesothorax and on the first eight of the ten abdominal segments; a rudimentary pair is found on the metathorax. The spiracles are provided with an effective closing mechanism (fig. 5), which prevents the expiration of the air, when the larva contracts the body to press out the bloodlike fluid from the glands.[1]

The three thoracic segments bear stout legs (fig. 3), which are inserted rather close together; their color is dark gray with the terminal margin of each joint shiny, black; the small, clawlike tarsi are black, with a seta near the base and are surrounded by curious, club-shaped hairs on the end of tibia (fig. 1). The anal segment (10 *abd*, figs. 1, 3) is bent downwards and forms a well-developed sucker, which is used in the locomotion.

## STRUCTURAL DETAILS OF THE MATURE LARVA.

Cranium (figs. 8, 9, 10) symmetrical, rectangular, twice as broad as long; occipital foramen of the same width as the cranium; head reaches further back above than below; ventrally the foramen is without any distinct chitinous margin, because the two epicranial halves are widely separated and the gula region (*gu*) is without any chitinization (fig. 10); hypostoma (*h*), strongly chitinized, with a distinct triangular posterior enlargement (*htri*, fig. 10). Labrum (*lr*, fig. 9), very large and semicircular, shaped like an eyeshade; anterior margin distally without any serration, ciliar fringe or marginal setae; clypeus ( postlabrum Lyonet) (*c*, fig. 9) indistinct because the chitinization of epistoma (*ep*) is but slightly developed, and only obvious near the dorsal articulation of the mandibles; frons (*f*) completely fused with epicranium (*ecr*), no indication whatever of the frontal sutures nor any epicranial suture;[2] three well developed lateral ocelli (fig. 1, *oc*, fig. 8) arranged, as the figures show, in a triangle just behind the antennal ring. The laterally placed antennal ring (*a*, figs. 8, 9) is strongly chitinized and surrounds the whole basal membrane of the antenna; the antenna is of about the same length as the mandible, conical with a big basal membrane (*bm*, fig. 8); first joint wide but rather short (*I*, fig. 8); second joint (*II*, fig. 8) as long as the first but only half as wide; from the membraneous distal end of the second joint is emitted on the outerside a small transversely divided third joint (*III*, fig. 8) and on the innerside a thin-walled, soft sensory filament (*fil*, fig. 8), which is a little longer and more slender than the third joint.

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[1] Compare A. G. Böving, Natural History of the Larvae of Donaciinae (International Revue der gesamten Hydrobiologie und Hydrographie, vol. 3, Biol. Suppl. I, 1910, p. 75).

[2] Compare the first-stage larva, mentioned on page 628.

The mandible (fig. 6) is falciform with acute apex and with a large flattened base, which is developed into a convex molar shaped portion (*mo*) above the flexor muscle (*fl*), and which is also flattened out above the extensor muscle (*ex*); between the molar part and the apical part (*apx*) is inserted a thin, broad, perlucid retinaculum (*rlm*); the basal portion bears externally one large scrobicular seta. The maxilla (fig. 10) is connected with hypostoma (*h*) by a large, oblong articulating membrane (*cm*, fig. 10) from the exterior margins of the cardo; the posterior half of this membrane contains a flat chitinous plate, in outline resembling a lobster claw (*lo*, fig. 10), but the plate is normally concealed, because that part of the membrane, as a rule, is invaginated below the cardo; cardo (*ca*) is rather large, well chitinized and dark separated from stipes by a fine suture; the ventral surface of the stipes is of the same size and character as cardo, but while cardo only consists of a ventral shell-shaped plate, stipes is a real tube-shaped joint, though its dorsal side, facing the mouth cavity, is chitinized only at its distal end (*std. I*, fig. 8), while the rest is soft-skinned and forms a part of the buccal membrane (*std. II*, fig. 7); the rest of the mouth cavity is formed by the underside of the labrum, the epipharynx (*eph*, fig. 4), the dorsal side of the rather indistinct ligula (*li*, fig. 9, 10), and the hypopharynx (*hy*, fig. 7), all of which are soft and fleshy; the distal end of stipes is closed by a membrane, (*stm*, fig. 10), which bears a big fleshy lacinia (*la*, fig. 10) and a short palpiger (*plg*, fig. 10); lacinia has ventrally a slightly chitinized brownish surface, which is very distinctly articulated with the rod-like, strongly chitinized interior margin of stipes (*str*, fig. 10); the anterior and dorsal part of the lacinia is soft skinned (*la*, figs. 9, 10), provided with a number of short sensory peg-like projections, with a few setae and with a two-jointed appendix, the rudimentary galea (*g*, figs. 8, 10);[1] palpiger (*plg*, fig. 10) is stiffened by a semicircular chitinization (*pgc*); it carries a three-jointed conical palpus, which is of nearly the same size and shape as the antenna, with the corresponding joints almost equal in length and width; the number and location of the setae are indicated in figure 10; apical joint with sensory papillae (*se*). Submentum (*sm*), mentum (*m*), and stipes labii (*l*) are fleshy and are fused together to such an extent, that the different regions can hardly be discerned; there is no connecting lobe between submentum and cardo and only a very faint boundary line between submentum and the big fleshy soft-skinned gula region (*gu*); this latter region is again fused with the thick collar-shaped skin in front of prothorax (fig. 1).

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[1] Compare (*a*) A. G. Böving, Natural History of the Larvae of Donaciinae, p. 12, (*b*) G. Dimmock, Algunas Coccinellidae de leuba, p. 301, in translation from the Spanish text: "I am inclined to believe that this appendix . . . will prove to be a rudimentary lobe (see plate 51, fig. 17)."

At the base of mentum, close to the posterior margin of stipes, is found a pair of large, slightly chitinized and indistinctly defined plates, each with two setae; at the middle of submentum, adjoining cardo, is found a similar, but smaller pair of chitinous plates, behind each of which is a single seta. The labial palpus (*lp*, fig. 8) is very short, two-jointed, with a well chitinized ring-shaped basal joint, and with a rounded apical joint, which is but slightly chitinized; ligula (*li*, fig. 10), the fused laciniae labiales, is not well defined, subtriangular, obtusely pointed. The mouth cavity (fig. 7) has in its floor a strongly developed, chitinized bridge (*br*, fig. 7), which limits hypopharynx posteriorly and sharply defines the entrance to the pharynx (*ph*); from this chitinization extend two pairs of chitinous rods, which form the margins relatively of the hypopharynx (*hr*, fig. 7), and the epipharynx (*er*, figs. 4, 7); the hypopharyngeal rod has an interior branch at the base; laterally in the corner of the mouth between the upper and lower pair of rods, the chitinous bridge terminates in a concave masticating surface, against which the convex basal part of the mandible works.

The thoracic segments conform in shape and size with the abdominal segments more than is normally the case in coleopterous larvae and it is not necessary to describe them separately. The tergal region of each segment is ventrally defined by a longitudinal, curved suture (*tp*, figs. 1, 2), the tergo-pleural suture or lateral furrow, Dimmock[1] (= antipleural suture Böving[2]) which is determined by two muscle marks and by the upper ends of the vertical suture (*vps*, figs. 1, 2) between the posterior pleural areas (3, 4, fig. 1) of one segment and the adjacent anterior pleural areas (1, 2, figs. 1, 3) of the following segment. The outlying areas of tergum occupy a considerable portion of the whole tergum. Dorsally they are limited by a line which can be traced by a series of muscle marks; the line starts at a muscle mark just in front of the spiracle and runs vertically upwards to another muscle mark immediately below the blood-exuding, repugnatorial gland (*bg*, figs. 1,2) and hence around and beyond this gland; on the thoracic segments, where there are no repugnatorial glands, the three muscle marks are, nevertheless, easily located; the next determining point is the terminus of a transverse dorsal suture (*tds*, figs. 1, 2),

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[1] Geo. Dimmock, Algunas Coccinellidae, etc., p. 295: en los segmentos abdominales de las larvas de muchas especies entre la segunda y tercera hilera dorsal hay un canal longitudinal más ó menos definido que ha sido llamada en este articulo "canal lateral," usando el mismo nombre en cuanto á las ninfas.

[2] A. G. Böving, The Abdominal Structures, etc., p. 57.

which ends in a depressed, slightly chitinized rod, connecting two conspicuous muscle marks; the rod is approximately twice as long on the thoracic segments as on the abdominal segments; from the terminus of this rod the limiting line of the outlying tergal portion continues as a rather indistinct wrinkle to the mark below the gland of the next segment, and hence downward to the tergopleural suture.

This whole outlying tergal portion corresponds to what I before have called the spiracular area (*spa*, fig. 1). In most coleopterous larvae, however, including the majority of the Coccinellid larvae, the spiracles have moved away from this area on the thoracic segments, and the term "spiracular area" would consequently be misleading applied to these segments; while the term will be retained for the spiracle bearing abdominal areas, the homologous thoracic areas should be named "*the alar areas,*"[1] because it is from these areas, (*al*, figs. 1, 2) that the wing pads start on the second and third thoracic segments.[2] The central part of tergum is divided by the deep transverse suture (*tds*, figs. 1, 2) ending in the depressed chitinizations just mentioned in the foregoing; in front of this suture lies the anterior, trapezoidal portion of scutum (*sc I*, fig. 2), which contains a central transverse ridge of setae and a small, triangular prescutum (*psc*, fig. 2); behind the transverse line is the posterior portion of scutum (*sc II*, fig. 2) with a small, triangular, faintly outlined scutellar area (*scl*, fig. 2) opposite prescutum. Parascutum (*pasc*, figs. 1 and 2) is small and not sharply defined.

The outline of the pleural or lateral zone is concave above and below; dorsally it is defined by the tergopleural or lateral suture (*tp*, figs. 1, 2), ventrally by the sternopleural or sublateral suture (*stp*, fig. 3); the latter formerly referred to by the writer[3] as the pleural suture. On the thoracic segments this suture runs immediately above the conspicuous double chitinization with which coxa articulates, and on the abdomen[3] it connects the anterior and posterior cuneal notches (*an* and *pn*, fig. 3) and contains a small muscle mark on the middle of each segment. The pleural or lateral zone is large and bulges out prominently, so that only half of it can be seen from above, the other half from below. The pleural lobe (*pll*, fig. 3) is central and surrounded by the proto-, deutero-, trito- and tetrapleurites (1, 2, 3, 4*a*, 4*b*, figs. 13); these are all well developed, especially is the lower part (4*b*) of the tetrapleurite unusually large and cushion-like.

Both in the thoracic and the abdominal segments the areas below the pleural or lateral zone are the following: Hypopleurum, parasternum, presternum, sternum or eusternum, and sternellum. The hypopleurum (*pcx*, fig. 3) is comparatively small in the thoracic seg-

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[1] Following suggestion from Mr. F. C. Craighead.

[2] This can be observed in larvae which for any reason abnormally have developed wing pads.

[3] See Böving, The Abdominal Structures, etc., pp. 56–57.

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ments, but is here easily recognized by the double chitinization, into which the condyle of the coxa fits; the anterior portion of this chitinization is located at the end of a lateral armlike extension from eusternum in front of coxa; the abdominal parasternum (*past*, fig. 3) is large; the eusternum (*eust*, fig. 3) is separated from the sternellum (*stl*, fig. 3) by a transverse suture, which in thorax contains the furcal notches (*fn*, fig. 3); sternellum is approximately trapezoidal, posteriorly defined by a curved line through the unpaired ventral notch (*vn*, fig. 3) in the middle line of the body.

Between the head and the thorax is a broad, fleshy collar; the ventral side of this collar contains a median area (*mea*, fig. 3) in which is found a small unpaired chitinization; on either side of this area is a triangular area (*ta*, fig. 3); this latter area is correspondingly developed along the anterior margin of the sternum of meso- and metathorax, but is rudimentary on the abdominal segments; it is considered a lateral presternum (*prst*, fig. 3); in front of it on meso- and metathorax is a median notch-bearing area, the morphological nature of which can be decided only by a thorough study of the muscles, for which the available material is not in proper condition; this area (fig. 3) may, for the present, with equal right be regarded as a separate piece of the preceding sternellum, as a special posterior sternal area, as a median part of presternum, or as a special area, homologous with the median area (*mea*) of the collar. It is possible that the areas containing the large, repugnatorial glands (*bg*, fig. 1) may be interpreted as remains of the intersegmental skin, which otherwise can only be traced on the abdomen as a line. The tenth abdominal (10 *abd*, fig. 3) or anal segment is bent downwards, so that the ventral portion becomes anterior and the dorsal posterior; the anterior portion is a little smaller than the posterior and the latter is divided by a wedge-shaped depression; anus is central.

Legs are well developed; the base of coxa (*cox*, fig. 3) is large and oblique. The general form and relative size of the trochanter (*tro*), femur (*fe*), tibia (*tib*) and tarsus (*tars*) can be gathered from figures 1 and 3. The claw-shaped tarsus is rather small, curved, pointed with rounded heel; it is surrounded by peculiar club-shaped setae situated on the end of the tibia.

The spiracles (*sp.*, figs. 1 and 5) are all of the same size, ring-shaped and, what is especially noteworthy, placed dorsally both on the thoracic and on the abdominal segments. The rudimentary metathoracic spiracle is represented by a minute chitinous dot. The atrium is not developed and there are no hairs in the spiracular opening; the closing mechanism is two-armed; beneath the base of the one arm (*arm*, fig. 5) the tracheal wall is invaginated into a soft-walled cushion, slightly chitinized only on the upper surface; by the contraction of the closing muscle these underlying portions of the tracheal wall are pressed against each other, resulting in a very effective closing of the trachea.

There are in all, four larval stages; the second and third agree in general with the fourth stage here described, but the first larval stage presents a few deviations. The head of this first stage larva is comparatively larger than in the later stages, the body is more slender and the legs comparatively longer; but the most interesting difference is found in the last joint of the maxillary palpus, which relatively is more than twice as long as in the mature larva, and in the cranium being uniformly black with a trifurcated white pattern indicating the two frontal sutures and the epicranial suture. Otherwise this first larval stage agrees with the last larval stage in the structure of the mandibles, the hypopharyngeal bridge, the number of ocelli, and the arrangement of the body areas.

## SYNOPSIS OF THE LARVAE OF THE COCCINELLIDAE IN UNITED STATES NATIONAL MUSEUM.

The larvae of the family Coccinellidae exhibit a great variation of structure. They can, however, only be confused with certain larval types of the family Chrysomelidae, which they resemble in general shape and in the development and arrangement of the chitinous plates and spines of the body areas. Except the very deviating herbivorous larvae of the Epilachnini the rest of the Coccinellid larvae may definitely be separated from those of the Chrysomelids with which they may be confused by the following differences in the structures of the head and mouth parts.

In the Coccinellidae the mandible is sickle-shaped with the base enlarged and (except in the small genus *Microweisea*) with a retinaculum present; a hypopharyngeal bridge is developed. In the Chrysomelid types referred to, on the other hand, the mandible is broad with base not especially enlarged and without retinaculum; the hypopharyngeal bridge not developed. All the *Coccinellid* larvae examined by the writer possess three ocelli, while in the Chrysomelidae the number of eyes varies from none to six. It has been maintained that the larvae of the family Coccinellidae could be definitely distinguished by two depressions on the middle of the frontal suture, but our knowledge of these structural details is too limited to definitely establish them as a family character.

The *Hyperaspis* larva described above represents the primitive type of the Coccinellidae, while the *Chilocorini* possess the most highly developed larvae; between these two extremes is found a series of intermedian forms; the *Epilachnini* and the *Psylloborini* are branches from the main stem with biological adaptations, such as specialized mandibles (in both of the groups), and reduction of the hypopharyngeal bridge (in the *Epilachnini*).

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The following genera are represented in the United States National Museum, several of them by more than one species:[1] *Hyperaspis, Thalassa, Brachyacantha, Microweisea, Stethorus, Scymnus, Cephaloscymnus, Cryptolaemus, Novius* (*Vedalia*), *Lindorus, Rhyzobius, Micraspis, Anisosticta, Megilla, Hippodamia, Adalia, Coccinella, Harmonia, Neda, Cycloneda, Anatis, Synonycha, Thea, Psyllobora, Epilachna, Lasia, Cynegetis, Curinus, Axion, Exochomus, Egius, Orcus, Chilocorus.* In the subsequent synopsis these genera are arranged in nine groups, namely (1) *Hyperaspini*, (2) the genus *Microweisea*, (3) *Scymnini*, (4) *Noviini*, (5) *Rhyzobiini*, (6) *Coccinellini*, (7) *Psylloborini*, (8) *Epilachnini*, and (9) *Chilocorini*.

These nine groups are differentiated, as shown on plate 120, by the following characters:[2]

Primarily:

(1) The location of the thoracic spiracles; these are situated either in tergum or in the protopleurite.

(2) The arrangement of the pleural areas of meso- and metathorax; these are either similar to the corresponding, normally arranged pleural areas of the abdomen, or differ from these in having the *protopleurite* more or less fused with the adjacent part of tergum into a triangular region, which extends downwards to the sterno-pleural suture, and in having the *pleural lobe* fused with the *posterior pleurites* into another triangular region, which extends upwards from the sternopleural suture.

(3) The presence or absence, distribution, or modification of processes, tubercles, plates, or spines on the thoracic and abdominal areas.

Secondarily:

(4) The different development and chitinization of the hypopharyngeal bridge.

(5) The shape of the apex and the retinaculum of the mandibles.

The relationship of the genera and groups is, as far as possible, indicated by the sequence within the columns of plate 120.

It is noteworthy that this systematic arrangement, based on structures of the larvae, corroborates the classification based on structures of the adults, proposed by Col. Thomas L. Casey,[3] deviating only in a few points; thus the study of the larvae does not support a separation between a tribe *Hypodamiini* and a tribe *Coccinellini*. The genus *Microweisea* (=T. L. Casey: the genus *Smilia*, Weise) forms, as Weise and Casey have pointed out for the imagoes, an extremely remarkable and isolated type which can not be included within the tribe *Scymnini;* the larvae also indicate that this genus constitutes a separate tribe. Colonel Casey states that the two genera *Psyllobora* and *Thea* are so closely related to each other, "that it might scarcely be conducive to taxanomic convenience to maintain them distinct"; the study of the larvae which are readily identified by the characteristic shape of their mandibles (fig. 10, pl. 120), support this view. On the other hand, the comparison between the larvae of the *Psylloborini* and the *Epilachnini* does not support Colonel Casey's opinions, when he regards the *Psylloborini* and the *Epilachnini* so closely related, that he considers the *Epilachnini* merely as slightly modified *Psylloborini* "by reason of perverted food habits and attendant environments." While the larvae of the *Psylloborini* are rather close to the *Coccinellini,* the larvae of the *Epilachnini* differ considerably from both of them in a great many characters. The *Epilachnini* are truly derived from the *Coccinellini*, but are so adapted and changed that they form a very distinct tribe.

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[1] The large number of Danish forms is due to the gifts of Messrs. Kryger and Rosenberg, of Copenhagen.

[2] As muscle impressions corresponding to those described in *Hyperaspis binotata* are present in all Coccinellid larvae, and as the areas defined by them consequently can be identified with the homologous areas in *Hyperaspis*, all tubercles, sclerites, spines, or glands are referred to these special areas and named after them.

[3] A Revision of the American Coccinellidae, Journ. New York Entom. Soc., vol. 6, 1898.

### Group I (HYPERASPINI).

Plates 118-120.

Of this group the following genera and species have been studied: *Hyperaspis lugubris* Randall (N. Amer.), *Hyperaspis binotata* Say (N. Amer.), *Thalassa montezumae* Mulsant (Arizona), *Brachyacantha ursina* Fabricius (Washington, D. C.), *Brachyacantha,* sp. (Texas).

The body in dorsal view is ovate, with greatest width on the third and fourth abdominal segments; much flattened ventrally and very convex dorsally. Prothorax oblong-oval, more than twice as broad as long, the dorsal outline of the other segments, both thoracic and abdominal, is approximately rectangular, laterally rounded, comparatively broader and shorter than prothorax; the ninth abdominal segment nearly semicircular, more than twice as broad as long, with an unserrated margin. The folds and areas of mesothorax and meta thorax are very similar to those of the abdominal segments, which indicates the primitive nature of the group; the spiracles are all tergal and the spiracle-bearing areas are developed nearly alike in the thoracic and the abdominal segments. The tergopleural suture is horizontal and well defined throughout its whole length; the pleural lobe is convex, cushion-like, ovate, and the protopleurite is not fused with the adjacent part of tergum. Both thorax and abdomen have small chitinizations, indicating the attachment of muscles, but have no setiferous tubercles or spines. The hypopharyngeal bridge is strongly chitinized with a cavity in each end, into which the molar-shaped interior base of the mandible fits; the apex of the mandible is single, and the retinaculum is thin-walled with a single-pointed tip.

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### Group II (Genus MICROWEISEA).

Plates 120 and 121, figs. 22 *a*, *b*.

The group contains only the one genus *Microweisea*. Three species are present in the collections of United States National Museum, viz: *Microweisa misella* LeConte (N. Amer.), *Microweisea coccidivora* Ashmead (N. Amer.) and *Microweisea ovalis* LeConte (=*felschei* Weise) (Florida).

The body is depressed, fusiform, greatest width on metathorax; prothorax oblong-oval, about twice as broad as long; mesothorax and metathorax also oblong-oval, only slightly broader and longer than prothorax; the abdominal segments subrectangular, laterally rounded, relatively broader and shorter than the thoracic segments; the ninth abdominal segment conical, much narrower than the eighth, half as broad as long. The folds and areas of mesothorax and metathorax and of the abdomen are similar to those found in the *Hyperaspini*, with which group *Microweisea* also agrees in shape and nature of the spiracle-bearing areas of mesothorax and metathorax and in the transverse-oval dorsal outline of these segments as well as in the shape and position of the thoracic pleural areas below a well defined, horizontal tergopleural suture. A pair of longitudinal dark chitinizations is found on the tergum of the prothorax and is indicated on the tergum of mesothorax and metathorax; a ring-shaped dark chitinization surrounds the eighth, and a similar chitinization the ninth abdominal segment; the rest of the body is soft skinned, without setae-bearing tubercles or sclerites. The head (fig. 22 *a*, pl. 121) is quite different from that of any other Coccinellid larva. It is elongate with a comparatively narrow spear-like frons, which on its inner side has a long, thin, dark chitinized rod-like thickening along the median line. The hypopharyngeal bridge and the mandibles (fig. 17, pl. 120) have the same general shape as in the preceding group, and the apex of the mandible is single-pointed as in this group, but the retinaculum is absent in all three species examined, a condition which the writer has not observed in any other Coccinellid larva. The claws are unusually slender, rather straight, pointed and about four times longer than the width of the base. *Microweisea* is undoubtedly close to the *Hyperaspini* and also shows affinity to the *Scymnini*, but it constitutes a sharply defined, distinct type.

### Group III (SCYMNINI).

Plates 120 and 121, figs. 23, 24, 25 *a*, *b*, and 26.

The following genera and species, included in this group, have been studied: *Stethorus punctum* LeConte (N. Amer.), *Stethorus utilis* Horn (Florida), *Scymnus cervicalis* Mulsant (Texas), *Scymnus coniferarum* Crotch (Arizona), *Cephaloscymnus* (?), *sp.* (Arizona) and *Cryptolaemus montrouzieri* Mulsant (California).

The form of the body varies much; in some species, as *Scymnus coniferarum*, it is elongate fusiform with prothorax obovate, more than twice as long as broad, and, with the ninth segment conical, twice as long as broad, much narrower than the eighth segment; in other species, as *Scymnus cervicalis*, the form is rather broad with the segments of about the same size and only slightly tapering posteriorly, the prothorax is trapezoidal, anteriorly broadest, laterally rounded, about twice as broad as long, and the ninth segment is semicircular, about twice as broad as long, and not much narrower than the eighth segment; still in other species, as *Cephaloscymnus* (?), the general shape is the same as in *Scymnus cervicalis*, but all segments have laterally peculiar large prolongations. The outline of mesothorax and metathorax of the group is that typical for the majority of the Coccinellid larvae; it is trapezoidal, broadest in front, and differs from the transversal-oval dorsal outline, characteristic of the foregoing groups and still characteristic of the abdominal segments of the present and the subsequent group. This trapezoidal form is mainly due to the following development of the mesothoracic and metathoracic pleural areas (fig. 13, pl. 120). As mentioned previously (page 629), the mesothoracic and metathoracic spiracles move down into the protopleurite; and this area fuses more or less closely with the adjacent part of the tergum and also with the deuteropleurite into a subtriangular region, thus giving the impression as if the anterior portion of the spiracle bearing tergal area had been enlarged and dropped downward to the sternopleural suture. There it touches and is more or less confluent with the upper edge of the elongate, triangular, swollen, presternal area (*prst*, fig. 3, pl. 118) which points downward to and normally touches the unpaired ventral notch. The spiracle-bearing extension does not carry any setiferous tubercle or spine. By the development of this anterior pleurite the rest of pleurum is forced backward, and fused into the swollen, subtriangular region, which extends upward from the sternopleural suture in its entire length to the terminus of the tergopleural suture. On the thoracic segments a pair of longitudinal chitinizations occur on the terga, and, on the abdominal segments a small setae-bearing tubercle is developed on the scutal area, on the spiracular area just below the small parascutal area, on the pleural lobe, and on some of the sternal areas. In *Cephaloscymnus* (?), deviating in many ways, the pleural lobe is extraordinarily developed into a broad horizontally flattened, setae-bearing process (fig. 24, pl. 121); similar structures have been described in other *Scymnini*. The hypopharyngeal bridge is strong; the mandible has a molar-like base and the apex of the mandible is single in all the genera and species represented in the United States National Museum, except *Cryptolaemus montrouzieri*, in which form the apex is divided into two teeth; in the literature, however, several

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other species of Scymnid larvae have been described with a bifurcate mandibular apex; the retinaculum is always thin-walled and has a single-pointed tip.

The *Scymnini* are difficult to define and place as a group. Based on the few characters used in the present paper, a form as *Cryptolaemus*, for instance, with its bifurcate mandibular apex should logically be included in the following group, the *Coccinellini*, but the general habitus of the larva is very different from that of the Coccinellini and agrees well with that typical for many *Scymnini*. It seems advisable for the present to include all the genera mentioned as *Scymnini* in this one group.

### Group IV (NOVIINI).

**Plates 120 and 121, fig. 27.**

This group contains but the one genus Novius upon which Ganglbauer[1] has based his tribe the *Noviini*.

The only species represented in the National Museum is *Novius cardinalis* Mulsant.

The dorsal outline of the body is ovoid with its maximum width at the third abdominal segment. Prothorax is trapezoidal, about half as broad as long, anteriorly and laterally broadly rounded; the ninth abdominal segment is nearly semicircular, half as long as broad, anteriorly somewhat narrower than the eighth abdominal segment, posteriorly without any serration or crenation. The thoracic spiracles are placed in the protopleurite, and the shape of the pleural areas is as in the foregoing group, but the *Noviini* differ from the *Scymnini* by having a setiferous tubercle developed in the subtriangular extension from tergum. Prothorax has on each side of the middle line two longitudinal chitinous patches; on mesothorax and metathorax is a small setae-bearing tubercle on each scutal area, close to a large chitinization in the alar area (see page 626).

Small chitinizations with a few setae occur on each of the scutal areas of the abdominal segments and still smaller chitinizations are found on the abdominal spiracular areas. Well developed setae-bearing tubercles are present on the pleural lobes of all segments. The areas below the sternopleural suture exhibit no special structures. The hypopharyngeal bridge is strong, the interior portion of the base of the mandible is molar-shaped, the tip of the mandible single-pointed; retinaculum is simple and thin-walled.

### Group V (RHYZOBIINI).

**Plates 120 and 121, figs. 32*a*, *b*,**

The two following genera and species, included in this group, have been examined: *Rhyzobius ventralis* Erichson (California) and *Lindorus lophantae* Blaisdell (California).

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[1] Die Käfer von Mitteleuropa, vol. 3, pt. 2, p. 977.

The general form of the body as in the *Noviini;* the prothorax and ninth abdominal segment are crenated; setae-bearing processes from the pleural lobe are developed as in *Cephaloscymnus* (?), but characteristic for the group is the possession of setae-bearing processes, also from the lateral margins of the tergum of the segments. The mesothoracic and metathoracic spiracles are placed in the protopleurite, and the protopleurite of these segments is incorporated in a subtriangular extension from tergum, as in the *Scymnini* and *Noviini;* the protopleural portion of the extension is clearly separated from the tergal part by the well-defined tergopleural suture. A setae-bearing tubercle is found on this extension as in the Noviini. The hypopharyngeal bridge is strong, the interior portion of the mandibular basis is molar-shaped; the tip of the mandible is bifurcate; retinaculum simple and thin-walled.

### Group VI (COCCINELLINI).

Plates 120 and 121, figs. 28, 29.

The following genera and species of this group have been studied: *Micraspis 12-punctata* Linnaeus (Denmark); *Anisosticta 19-punctata* Say (Denmark); *Megilla fuscilabris* Mulsant (= *M. maculata* Degeer (N. Amer.)), *Hippodamia convergens* Guérin (N. Amer.), *Hippodamia ambigua* LeConte (California), *Hippodamia glacialis* Fabricius (N. Amer.), *Hippodamia 13-punctata* Linnaeus (N. Amer., Denmark); *Adalia bipunctata* Linnaeus (Washington, D. C.), *Coccinella 7-punctata* Linnaeus (Denmark, Hungaria), *Coccinella repanda* Thunberg (Hawaii); *Coccinella variabilis* Illiger (Denmark); *Coccinella oculata* Fabricius (N. Amer.); *Coccinella 9-notata* Herbst. (N. Amer.); *Coccinella sanguinea* Linnaeus (Cuba, Florida); *Harmonia picta* Randall (N. Amer.); *Neda marginata* Linnaeus (Mexico, N. Amer.); *Cycloneda abdominalis* Say (?) (Mexico, N. Amer.); *Anatis 15-punctata* Olivier (N. Amer.); *Synonycha grandis* Thunberg (Java).

The body is fusiform, in most genera with the greatest width at metathorax; the sides of the abdomen are straight and the segments diminish gradually posteriorly; the outline of prothorax varies from nearly trapezoidal, about twice as wide as long, with the largest width posteriorly, to approximately crescent shaped. The ninth abdominal segment is somewhat conical, half as broad as long, or longer, considerably narrower than the eighth segment, laterally unarmed, never serrated or crenated as in many preceding forms and never darkly chitinized as in *Microweisea.* The mesothoracic and metathoracic spiracles are situated in the large protopleurite. This is subtriangular blunt, downwards directed, in some genera not limited dorsally by any distinct tergopleural suture, in other genera with a distinct suture. A setiferous tubercle is never developed in the spiracle-bearing region as is the case in the *Noviini* and *Rhyzobiini.* The rest of pleurum has the triangular shape typical of the majority of the Coccinellid larvae. In most of the genera sclerites are developed in prothorax, and, when present, the sclerites of scutum and the marginal area of tergum are fused together; they are flat, covered with setae or developed into setiferous spines. On mesothorax and metathorax a rather small flat or spinose scutal sclerite is more or less confluent with a large, flat or spinose sclerite in the alar area just below the parascutum. The triangular pleural lobe, the hypopleural area and the eusternum have only small chitinizations. The abdominal segments have a setiferous flat or tubercle-shaped or spinose sclerite on the scutal area, another similar one on the spiracular area and a third on the pleural lobe; the surface of the hypopleural area, the parasternum and the eusternal area is normally only slightly chitinous. The hypopharyngeal bridge is strong, the inner portion of the basis of the mandible is molar-shaped, the apex of the mandible is bifurcate; in *Synonycha grandis*, however, the tip of each of the principal teeth is divided into two teeth, a large distal and a smaller proximal one. The retinaculum is developed as a straight, single, strongly chitinous tooth.

### Group VII (PSYLLOBORINI).

Plates 120 and 121, fig. 30.

The tribe *Psylloborini* has been established by T. L. Casey on the genera *Psyllobora*, *Thea*, *Halyzia*, and *Neohalyzia*. The tribe is represented in the United States National Museum by larvae of the following species: *Psyllobora parvinotata* Casey (Cuba, Florida), *Psyllobora vigintimaculata* Say (N. Amer.), and *Thea 22-punctata* Linnaeus (Denmark).

In the general shape of the body and its parts, in the development of the mesothoracic and metathoracic spiracle-bearing protopleurite into a triangular extension from the tergum, in the character, presence and distribution of sclerites or setiferous tubercles this group is closely connected with the less specialized genera of the *Coccinellini*. The body is soft-skinned; on each side of the tergum of prothorax one (*Psyllobora*) or two (*Thea*) setae-bearing sclerites; setae-bearing tubercles are found in mesothorax and metathorax in the scutum, the alar area and the pleural lobe; setae-bearing tubercles are also found in the same areas on the abdominal segments. The ventral areas below the sternopleural suture have small tubercles on the hypopleural parasternal and eusternal areas. The hypopharyngeal bridge and interior base of the mandible as in the *Coccinellini*, but the rest of the mandible differs from that of all the other *Coccinellini* in having the apex produced into five teeth and the thin-walled retinaculum into five teeth (*Psyllobora*) or several small rounded elevations (*Thea*).

### Group VIII (EPILACHNINI).

Plate 120 and plate 121, figs. 31*a*, *b*.

The following genera and species of this group are represented in the United States National Museum: *Epilachna corrupta* Mulsant (Mexico, Colorado, Panama), *Epilachna borealis* Fabricius (N. Amer.), *Lasia globosa* Schneider (Denmark) and *Cynegetis impunctata* Linnaeus (Denmark).

This group is allied to the *Coccinellini*, having like this tribe an unarmed spiracle-bearing extension from the terga of mesothorax and metathorax. The protopleural portion of the extension is sharply defined by the tergo-pleural and the sterno-pleural sutures, which separates the portion respectively from the alar area and the presternum. The development of long, more or less conspicuously branched spines on all the segments is a specialization, which is only indicated in the *Coccinellini;* on the ventral areas small tubercles are present in the same distribution, number and development, as in the *Coccinellini*. In the form of the hypopharyngeal bridge and of the mandibles, this group, however, occupies as already mentioned (page 628) an isolated position among all Coccinellid larvae. It is noteworthy that the anterior portion of the head and the development of antennae and palpi also exhibit special characters; finally an epicranial suture is present, a character, which, outside this group, only occurs in the three closely related genera, *Chilocorus*, *Egius*, and *Orcus*.

The dorsal side of the prothorax is well chitinized and has on each side two large spines with an intervening small spine; in *Cynegetis* a small spine is developed from the small prothoracic pleural lobe. The scutal areas of thorax and abdomen, the alar areas of mesothorax and metathorax as well as the corresponding spiracular areas of the abdominal segments and the pleural lobes of both the thoracic and the abdominal segments all carry a flat, thick sclerite with a long setiferous spine. The first abdominal spiracle is placed much more dorsally than on the other abdominal segments. This is especially so in *Cynegetis*. The hypopharyngeal bridge is lamelliform, slightly chitinized, in *Epilachna* with only a dark chitinous line along the posterior margin (fig. 16, pl. 120), and in *Cynegetis* even without that marginal thickening; there are no hard-walled lateral cavities in the bridge, and the grinding and squeezing mechanism, which is found in all the carnivorous Coccinellid larvae, is therefore totally lacking in the larvae of this herbivorous tribe. The mandible (fig. 21, pl. 120) is strongly chitinized at the base; it is not so broad as in the other groups and it has no molar-shaped portion. The retinaculum is not present in its normal place; as it, however, is strongly developed in the allied group *Coccinellini*, it is possible that it really is represented by the lower teeth of the unusually multidentate apex of the mandible.

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These teeth are of different length and in some of the species the larger ones are serrated. The inner margin of the mandible below the teeth is convex and comparatively long, one-half to two-thirds of the whole length of the mandible.

### Group IX (CHILOCORINI).

Plate 120 and plate 121, figs. 33*a*, *b*; 34; 35*a*, *b*.

Of this group the following genera and species have been examined: *Curinus coeruleus* Mulsant (Guatemala), *Axion*, sp. (Arizona), *Exochomus cubensis* Dimmock (Cuba); *Egius platycephalus* Mulsant (Cuba), *Orcus australasiae* Boisduval (Australia), *Chilocorus bivulnerus* Mulsant (N. Amer.), *Chilocorus renipustulatus* Scriba (Denmark), *Chilocorus cacti* Linnaeus (Mexico, Arizona).

The group *Chilocorini* represents, as stated above, the final stage in the evolution of the normal, carnivorous Coccinellid larva; they belong to the subovate type, which includes the broader forms of the *Scymnini* larvae, the *Noviini* and the *Rhyzobiini*, rather than to the fusiform type, which includes the elongate forms of the *Scymnini* larvae, the Coccinellini and the Psylloborini. The maximum width is at metathorax, but this segment is only slightly wider than prothorax and mesothorax and the first three abdominal segments; the other abdominal segments narrow gradually to the ninth abdominal segment; this segment is about twice as broad as long, anteriorly not much narrower than the posterior edge of the eighth segment, broadly rounded posteriorly with an unserrated margin. The areas of the whole body carry spines of varying length. The pleurum is developed as in the foregoing groups; on mesothorax and metathorax with a spiracle-bearing, subtriangular protopleurite and with the opposite subtriangular region large. The protopleurite is separated from the tergum by a distinct tergo-pleural suture, but is confluent with presternum. On mesothorax the protopleurite carries a large setiferous spine; on metathorax it also bears a spine, but this differs considerably in the different species; it is for example rudimentary in *Chilocorus renipustulatus*, half as long and thick as the corresponding spine of mesothorax in *Chilocorus cacti* and *bivulnerus*, and it is as long and thick as the spine of mesothorax in *Exochomus cubensis*.

The alar area carries according to the genus one, two, or three spines.[1] A well-developed setiferous spine is always present on the larger subtriangular area behind the protopleurites of mesothorax and metathorax, while the arrangement of the other spines on thorax varies as described below. On the abdominal segments, except in some genera on several of the posterior abdominal segments, the scutal, the spiracular areas and the pleural lobe are armed with a well developed spine; no spines on the areas below the sternopleural sutures. The hypopharyngeal bridge is strongly chitinized; the inner portion of the base of the mandible is molar-shaped; the retinaculum is present, in some genera well chitinized, in others delicate and simple. The apex of the mandible varies within the tribe. It is simple in *Curinus*, *Axion*, and *Exochomus*, but bifurcate in *Egius*, *Orcus*, and *Chilocorus*. This development of the mandible may indicate a division of the tribes into two natural groups, and other characters support the same view.

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[1] In reality a single spine with one or two large branches coming out from the base of the spine.

In the first group no epicranial suture is present, the posterior angle of the frons reaching the occiput; no medio-posterior spine on each side of the tergum of prothorax; one to four marginal spines; no scutal spine or only a rudiment of it on mesothorax and metathorax

In the second group a very conspicuous epicranial suture is present (fig. 35*a*, pl. 121); one rather short medio-posterior spine on each side of the tergum of prothorax; four or more marginal spines; a scutal spine is always developed on mesothorax and metathorax.

## BIBLIOGRAPHY.[1]

1749. Albin, E.—A Natural History of English Insects. London. pl. 61.

1894. Ashmead, Wm. H.—Notes on Cotton Insects found in Mississippi. Ins. Life, vol. 7, pp. 240-47.

1895.—Baker, C. F.—Biological Notes on Some Colorado Coleoptera. Ent. News, vol. 6, pp. 27–28.

1906. Banks, Charles S.—The Principal Insects Attacking the Coconut Palm. (Part II) Philippine Journ. Sci., vol. 1, pp. 211-222, pl. 8.

1845-1913. Bericht über die Wissenschaftlichen Leistungen im Gebiete der Entomologie. Archiv. f. Naturg., Berlin.

1873. Bethune, C. J. S.—Beneficial Insects. 3rd Rept. Ent. Soc. Ont., pp. 59–75, figs. 81–4.

1891. Beutenmüller, Wm.—Bibliographical Catalogue of the Described Transformations of North American Coleoptera. Journ. N. Y. Micros. Soc., vol. 7, pp. 1–52.

1896–98. Boas, J. E. V.—Dansk Forstzoologi. Copenhagen.

1906. Boeker, P.—Nutzen der Coccinellen-Larven. Arb. Kaiserl. Biol. Anst. Land.-und Forstw., vol. 5, p. 282.

1841. Boie, F.—Cynegetis globosa. Stett. Ent. Zeit., vol. 2, p. 79.

1745. Bonnet, Charles.—Observations sur les Pucerons. Paris.

1891. Bos, I. Ritzema.—Thierische Schädlinge und Nützlinge für Akkerbau, Viehsucht, Wald- und Gartenbau, Berlin.

1833. Bouché, P. Fr.—Naturgeschichte der Schädlichen und Nützlichen Garten-Insekten . . . Berlin, pp. 145–146.

1847. ————. — Beiträge zur Kenntniss der Insekten-Larven. Stett. Ent. Zeit., pp. 162–165.

1914. Böving, A. G.—On the Abdominal Structure of Certain Beetle Larvae of the Campodeiform Type. Proc. Ent. Soc. Wash., vol. 16, pp. 55–61, pls. 3-6.

1721. Bradley, Richard.—A Philosophical Account of the Works of Nature. London.

1903. Britton, W. E.—Three Natural Enemies of the San José Scale—Insect in Connecticut. 2d Rept. Sta. Ent. Conn., 1902. pp. 127–130, fig. 2.

1905. ————Description of the Larva of Delphastus pusillus Lec., with Notes on the Habits of the Species. Can. Ent., vol. 37, pp. 185–186.

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[1] I am indebted to Miss Margaret M. Fagan, of the Division of Forest Insects, who has compiled these references for me.

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1911. Britton, W. E.—The 15-Spotted Lady Beetle. Tenth Rept. Ent., Conn. Agr. Exp. Sta., 1910, p. 705, fig. 21.

1881. Brossay, Chiron W.—Observations Coléoptérologiques. Le Naturaliste, Paris, vol. 3, p. 341.

1884. Buddeberg.—Beiträge zur Biologie einheimischer Käferarten. Jahrb. Nassauisch. ver. Naturk., vol. 37, p. 70.

1903. Burgess, A. F.—Economic Notes on the Family Coccinellidae. U. S. Dept. Agr. Div. Ent., Bull. 40 (new ser.), pp. 25–32.

1912. ——— and Collins, C. W.—The Value of Predaceous Beetles in Destroying Insect Pests. U. S. Dept. Agr. Yearbook, 1911, pp. 453–466.

1906. Busse, Walter.—Bericht über die Pflanzenpathologische Expedition nach Kamerun und Togo, 1904–5. Tropenpflanzer, X, Beiheft 7, pp. 163–262, 3 pls. (Über einige Schädlinge sonstiger Kulturpflanzen in Togo, pp. 215–220.)

1861. Candèze, E.—Histoire des Métamorphoses de Quelques Coléoptères Exotiques. Mem. Soc. Sci. Liège, vol. 16, p. 327, 6 pls.

1853. ——— and Chapuis, F.—See Chapuis and Candèze.

1912. Carnes, E. H.—Some Experiments with the Common Ladybird (Hippodamia convergens). Mon. Bull. Sta. Comm. Hort. Calif., vol. 1, pp. 821–826.

1876. Chapuis, F.—Coccinellides. In Lacordaire: Genera des Coléoptères, vol. 12, pp. 149–160.

1853. ——— and Candèze, E.—Catalogue des Larves des Coléoptères. Mem. Soc. Ent. Liège, vol. 8, pp. 351–656.

1897. Chittenden, F. H.—The Asparagus Beetles. U. S. Dept. Agr. Yearbook, 1896, pp. 341–352, fig. 87.

1898. ———.—Insects Injurious to Beans and Peas. U. S. Dept. Agr. Yearbook, pp. 233–260.

1899. ———.—The Squash Ladybird; Its Literature and Biology. U. S. Dept. Agr. Div. Ent., Bull. 19, pp. 11–20.

1903. ———.—A brief Account of the Principal Insect Enemies of the Sugar Beet. U. S. Dept. Agr. Div. Ent., Bull. 43, pp. 59, fig. 58.

1906. ———.—The Melon Aphis. U. S. Dept. Agr. Bur. Ent., Circ. 80.

1909. ———.—The Pea Aphis. U. S. Dept. Agr. Bur. Ent., Circ. 43, Ed. 2, fig. 2*a*.

1915. Cholodkowsky, N. A.—Chermes Injurious to Conifers. Dept. Agr. Centr. Bd. Land Admin. Petrograd, 89 pp.

1885. Chyzer, Béla.—A katicabogár a magyar gyermekköltészetben. Rov. Lapok, vol. 2, pp. 211–214.

1886. ——— (Note on Cannibalism of Coccinellidae.) Rov. Lapok, vol. 3, p. 107.

1915. Clausen, C. P.—A Comparative Study of a Series of Aphid-Feeding Coccinellidae. Journ. Econ. Ent., vol. 8, pp. 487–491.

1880. Clément, A. L.—Observations sur les premiers états du Scymnus minimus Payk. Ann. Soc. Ent. France, ser. 5, vol. 10, pp. 341–346, pl. 12.

1912. Collins, C. W. and Burgess, A. F.—See Burgess and Collins.

1879. Comstock, J. H.—Report Upon Cotton Insects. U. S. Dept. Agr. Washington.

1882. ———.—Report on Insects for the Year 1881. Ann. Rept. Dept. Agr. 1881, pp. 135–137, pl. 18.

1882. ———.—Report on Miscellaneous Insects. U. S. Dept. Agr. Rept. Ent., pp. 195–214, pl. 18.

1907. ———.—Manual for the Study of Insects.

1849. Coquerel, C.—Description de la larve et de la nymphe du Chilocorus uva Schönh. Ann. Soc. Ent. France, ser. 2, vol. 7, pp. 452–454, pl. 14, fig. 3.

1888. Coquillett, D. W.—The Australian Lady Bird. Ins. Life, vol. 1, p. 737.

1889. Coquillett, D. W.—The Imported Australian Lady-Bird (Vedalia cardinalis). Ins. Life, vol. 2, pp. 70–74, 2 figs.

1892. ————Report on the Scale-Insects of California. U. S. Dept. Agr. Div, Ent., Bull. 26, pp. 13–35.

1893. ————The Australian Enemies of the Red and Black Scales. Ins. Life, vol. 5, pp. 41–43.

1893. ————Report on Some of the beneficial and Injurious Insects of California. U. S. Dept. Agr. Ent., Bull. vol. 30, pp. 9–33.

1883–4. Cutting, H. A.—Insects. 8th Rept. Vermont Agr. Rept., pp. 247–277.

1893. Davis, G. C.—Celery Insects. Bull. 102, Agr. Exp. Sta. Mich., p. 18, fig. 9.

1775. Degeer, C.—Mém. pour servir á l'Histoire des Insectes, vol. 5, Stockholm, Mem. 7, 16 pls.

1906. Deventer, W. van.—Hanboek ten dienste van de Suikerriet-Cultuur en de Rietsinker-Fabricage op Java., Amsterdam.

1889. Dewitz, H.—Eigenthätige Schwimmbewegung der Blutkörperchen der Gliederthiere. Zool. Anz., vol. 12, pp. 457–64.

1884. Dimmock, George W.—Coleoptera. Standard Nat. Hist., vol. 3, p. 312.

1906. ————.—Algunas Coccinellidae de Cuba.[1] Primer Informe An. Est. Centr. Agron. Cuba, pp. 287–392.

1862. Döbner.—Beiträge zur Entwickelungsgeschichte einiger Coleopteren. Berl. Ent. Zeitschr., vol. 6, pp. 64–68.

1890. Duffey, J. C.—Transformations of a Carabid (Plochionus timidus) and Observations on a Coccinellid Enemy of the Red Spider. Trans. Acad. Sci. St. Louis, vol. 5, No. 3, pp. 533–42, pls. 10, 11.

1886. Dugés, Eug.—Métamorphoses de Quelques Coléoptères Mexicains. Ann. Soc. Ent. Belg., vol. 30, pp. 27–42, pl. 3.

1907. Elliott, E. A. and Morley, C.—On the Hymenopterous Parasites of Coleoptera. Trans. Ent. Soc. Lond., pp. 7–75.

1841–52. Erichson, W. F.—Zur systematischen Kenntniss d. Insektenlarven. Archiv f. Naturg., vols. 7–13.

1898–1903. Everts, T. E.—Coleoptera Neerlandica. Two volumes and supplement.

1915. Felt, E. P.—29th Rept. State Entomologist, 1913. Bull. 175, N. Y. Sta. Mus., 257 pp.

1915. Fink, D. E.—The Egg-Plant Lace-Bug. U. S. Dept. Agr. Bull. 239, 7 pp.

1856. Fitch, A. F.—Insects Infesting Fruit Trees. 1st Rept. Nox. Ins. N. Y., pp. 98–100.

1857. ————.—Insects Infesting Forest Trees. 2nd Rept. Nox. Ins. N. Y., pp. 259–62.

1865. ————.—6th Rept. Nox. Ins. N. Y., pp. 100–112.

1888. Fletchel, James.—Report of the Entomologist and Botanist. Rept. Exp. Farms, Ottawa, 1887, pp. 8–57.

1906. Folsom, J. W.—Entomology with Special Reference to its Biological and Economic Aspects. Phila.

1883. Forbes, S. A.—The Food Relations of the Carabidae and Coccinellidae. Ill. Sta. Lab. Nat. Hist. Bull., vol. 6, pp. 33–64.

1868. Frauenfeld, Georg Ritter von—Zoologische Miscellen. Verh. Zool.-bot. Ges. Wien, pp. 147–166.

1883. French, G. H.—Preparatory Stages of Epilachna borealis. Can. Ent., vol. 15, pp. 189–191.

1730. Frisch, Joh. Leonhard.—Von runden Blat- oder Marien Kefer der zweyten Grösse mit zwey Flügel-Puncten Insecten, pt. 9, No. 16, pp. 33–34, fig. 1.

---

[1] In the library of the United States National Museum in Washington is a typewritten copy of the original English manuscript from which the Spanish translation was made.

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1895. Froggatt, Walter, W.—Life Histories of Australian Coleoptera. Proc. Linn. Soc. N. S. Wales, vol. 10, pp. 325–336.

1902. ————.—Australian Ladybird Beetles. Agric. Gaz. N. S. Wales, Miscell. Pub. No. 592.

1899. Ganglbauer, L.—Die Käfer von Mitteleuropa., vol. 3, pt. 2, pp. 941–1023.

1868–76. Gemminger, M. and Harold, B. de.—Catalogus Coleopterorum.

1827. Gené.—Sugli Insetti piu nocivi alla Agricultura.

1762. Geoffroy, Etienne Louis.—Coccinella. Hist. Insectes, vol. 1, pp. 318–335.

1897. Giard, Alfred.—Sur les Métamorphoses d' *Hyperaspis concolor* Suffrian. Bull. Soc. Ent. France, p. 262.

1892. Gillette, C. P.—Observations upon Injurious Insects. Colo. Exp. Sta. Bull., No. 19.

1898. ————.—Colorado's Worst Insect Pests and Their Remedies. Colo. Agr. Exp. Sta., Bull. 47, p. 41, fig. 40.

1907. Girault, A. A.—Biological Notes on Megilla maculata de Geer. Journ. N. Y. Ent. Soc., vol. 55, 193–197.

1913. ————.—Fragments of N. American Insects. IV. Ent. News, vol. 24, pp. 195–97.

1787. Gleichen, W. F.—Versuch einer Geschichte der Blattläuse und Blattlausfresser der Ulmenbaumes.

1855. Glover, Townsend.—Insects. Rept. Comm. Pat., Agr. Rept., p. 113.

1700. Goedart, Jean.—Métamorphoses Naturelles ou Histoire Insects. Vol. 2, p. 67, Exp. 18; Exp. 15; Exp. 10 (Amsterdam).

1887–99. Gorham, H. S.—Biologia Centrali-Americana. Ins. Col. VII.

1913. Grandi, G.—Studi sui Coccinellidi. Boll. Lab. Zool. Portici, vol. 7, pp. 267–302, 27 figs.

1914. ————.—Descrizione di un nuovo Coccinellide africano. Boll. Lab. Zool. Portici, pp. 165–178, 8 figs.

1899. Hacker, P. Leopold.—Biologisches über Coccinelliden. Ill. Zeitschr. Ent., vol. 4, pp. 9; 60; 75; 90; 137–138; 169.

1862. Hagen, H. A.—Bibliotheca Entomologica. Leipzig.

1883. Harrington, W. H.—Chrysomelidae—Leaf-Eaters. Rept. Ent. Soc. Ont., 1882, p. 53.

1862. Harris, T. W.—A Treatise on Some of the Insects Injurious to Vegetation. P. 246, figs. 93, 94.

1869. ————.—Entomological Correspondence, p. 76.

1851. Heeger, Ernst.—Beiträge zur Naturgeschichte der Insecten. Sitzungsber. kais. d. Wiss., Wien, vol. 7, pp. 203–17.

1852. ————.—Beiträge zur Naturgeschichte der Insecten. Sitzungsber. kais, Akad. d. Wiss., Wien, vol. 9, pts. 1–5, pp. 263–86, pls. 26–30.

1853. ————.—Beiträge zur Naturgeschichte der Insecten. Sitzungsber. kais. Akad. Wiss., Wien, vol. 10, pp. 460–81, 6 pls.

1857. ————.—Beiträge zur Naturgeschichte der Insecten. Sitzungsber. kais. Akad. Wiss. Wien, vol. 24, pp. 315–334, 6 pls.

1858. ————.—Beitrage zur Naturgeschichte der Insecten. Sitzungsber. kais. Akad. Wiss. Wien, vol. 29, pp. 100–119. 6 pls.

1848. Heeger, G.—Beiträge zur Naturgeschichte der Kerfe. Isis von Oken, pt. 12, pp. 969–1002.

1793. Herbst, J. F. W.—Coccinellen. Käfer, vol. 5, pp. 255–256, pl. N, figs. 6–9.

1864. Heyden, L. von.—Nachtrag zum Beitrag der Coleopterenfauna des Oberengadins, insbesondere der Umgegend von St. Moritz. Jahresb. Naturf. Ges. Graubündens. Chur (new ser.), vol. 9, pp. 1–16.

1907. Holtz, Martin.—Über Adalia bipunctata L. typ. und deren Varietat sexpustulata L. Ent. Woch., 24 Jahrg., pp. 181–182.

1900. Howard, L. O.—Beneficial Work of Hyperaspis signata. U. S. Dept. Agr., Div. Ent. Bull. 26 (new ser.), pp. 17–18, fig. 1.

1896. ———, and Marlatt, C. L.—The San José Scale. U. S. Dept. Agr., Div. Ent. Bull. 3.

1888. ———, and Riley, C. V.—See Riley and Howard.

1885. Hubbard, H. G.—Insects Affecting the Orange. U. S. Dept. Agr., Wash.

1899. ———.—On Thalassa montezumae Muls. (Family Coccinellidae). Proc. Ent. Soc. Wash., vol. 4, p. 297, fig. 18.

1841–2. Huber, Pierre.—Mémoire pour servir á l'Histoire de la Coccinelle de la Saponaire. Mem. Soc. Phys. Geneve, vol. 9, pp. 363–377, pl., 6 figs.

1914. Iglesias, F.—Insectos contra insectos, as Coccinellidas. Rev. Mus. Paul., vol. 9, pp. 357–62.

1915. Insect Notes.—Month. Bull. Sta. Comm. Hort. Sacramento, Cal., vol. 4, pp. 285–86.

1864–1913. Insecta.—Zool. Record, London.

1907. Johnson, Roswell H.—Economic Notes on Aphids and Coccinellids. Ent. News, vol. 18, pp. 171–174.

1895. Judeich, J. F., and Nitsche, H.—Lehrbuch der Mitteleuropäischen Forstinsektenkunde. Wien.

1841. Junker, F. C.—Epilachna chrysomelina. Stett. Ent. Zeitg., vol. 2, pp. 2–5.

1867. Kawall, J. H.—(Coccin. 24-punctata). Stett. Ent. Zeitg., p. 123.

1905. Kellogg, V. L.—American Insects, p. 287, fig. 398.

1913. Kleine, R.—Das Ei von Propylaea 14-punctata L. Intern. Ent. Zeitschr., vol. 6, pp. 330–331, 5 figs.

1890. Koebele, Albert.—Report of the Fluted Scale of the Orange and its Natural Enemies in Australia. U. S. Dept. Agr., Bull. 21. Div. Ent.

1894. Kolbe, W.—Beiträge zur Larvenkenntniss Schlesischer Käfer. Zeitschr. Ent. Breslau, vol. 19, pp. 11–16.

1895. ———.—Beiträge zur Larvenkenntniss schleschischer Käfer. Zeitschr. Ent. Breslau, vol. 20, pp. 1–8.

1837. Kollar, V.—Naturgeschichte der Schädlichen Insecten in Bezug auf Landwirtschaft und Forstkultur.

1852. ———.—Notes on Epilachna globosa Ill. Verh. Zool.-Bot. Ges. Wien., vol. 2, pp. 24–25.

1835. Lamarck, J. B. P. A. de.—Histoire Naturelle des Animaux Sans Vertèbres. Paris, vol. 4, p. 479.

1904. Lampa, Sven.—Några af våra for Trädgården Nyttigaste Insekter. Ent. Tidskr., Stockholm, vol. 25, pp. 209–216, 1 pl.

1804. Latreille, Pierre.—Coléoptères. Hist. Nat. Crust. Ins., vol. 12, p. 46.

1874. Le Baron, Wm.—4th Rept. Noxious Ins. Ill., p. 184.

1887. Lemoine, V.—Note on larva of Scymnus sp. Bull. Soc. Ent. France, pp. IV–V.

1853. Letzner, K.—Beiträge zur Verwandlungs-Geschichte einiger Käfer. Denkschr. Schlesisch. Gesellsch. pp. 205–219.

1856. ———.—Larve und Puppe der Coccinella mutabilis Scrib. Jahres-Bericht Schlesisch. Ges. väterl. Kultur, pp. 108–09.

1857–8. ———.—Beiträge zur Verwandlungsgeschichte der Coccinellen. Zeitschr. f. Ent., vol. 11, pp. 3–24, 1 pl.

1866 (67). ———.—Über Coccinella (Adalia) undecimnotata Schneid. und ihre Stände. Jahresb. Abh. Schles. Ges., vol. 44, pp. 161–170.

1893. Lewcock, G. A.—Note on Coccinella ocellata L. The Entomologist, vol. 26, p. 249.

1885. Lintner, J. A.—2d Rept. Sta. Ent. N. Y. p. 186, figs. 50–53.

1888. ———.—4th Rept. of the Injurious and Other Insects of New York, pp. 80–83, fig. 34.

866

1891. Lintner, J. A.—7th Rept. on Injurious and Other Insects. N. Y., p. 311.

1911. Mann, Wm. M.—On Some Northwestern Ants and Their Guests. Psyche, pp. 102-109, 1 fig.

1897. Marlatt, C. L.—Insect Control in California. Yearbook U. S. Dept. Agr., 1896, pp. 217-235, figs. 51, 52.

1902. ———. Predatory Insects Which Affect the Usefulness of Scale-Feeding Coccinellidae. U. S. Dept. Agr. Div. Ent., Bull. 37, pp. 84-90.

1896. ——— and Howard, L. O. See Howard and Marlatt.

1910. Martelli, G. Sulla micofagia del Coccinellide Thea vigintiduo-punctata L. Boll. Lab. Zool. Portici, vol. 4, pp. 292-94, 1 fig.

1914-15. ———. Notizie su due Coccinellidi micofagi. Boll. Lab. Zool. Portici, vol. 9, pp. 151-60.

1907. Meier, Albert. Über die Nutzlichkeit von Coccinella 7-punctata. Soc. Ent. Zurich, vol. 22, pp. 75-76.

1893-94. Meinert, Fr.—Fortegnelse over Zoologisk Museums Billelarver. Ent. Medd., Copenhagen, vol. 4, pp. 310-314.

1906. Meissner, Otto. Die Aufenthaltsorte der Coccinelliden. Ent. Zeitschr., p. 187-88.

1907. ———. Ein Beitrag zur Biologie von Coccinella 14-punctata L. Ent. Woch., vol. 24, p. 112.

1907. ———. Beobachtungen über Regeneration bei Insekten. Ent. Woch., vol. 24, pp. 208-09. Leipzig.

1907. ———. Ex-ovo-Zucht von Coccinellidenlarven. Ent. Blatt., vol. 3, p. 88.

1907. ———. Kannibalismus bei Coccinelliden. Wien Ent. Zeit., vol. 26, p. 322

1909. ———.—Lebensgeschichte des zweipunkts, Adalia bipunctata L. Ent. Blätt., vol. 6, p. 228-30.

1909. ———. Die Relative Häufigkeit der Varietäten von Adalia bipunctata L. in Potsdam (1908) und an einigen Anderen Orten, nebst Biologischen Bemerkungen. Zeitschr. Wiss. Insektbiol., vol. 5, pp. 231-42.

1905. Mjöberg, E. Biologiska och morfologiska studier öfver Faröns insektfauna. Arkiv. Zool., II, No. 17.

1907. Morley, C. and Elliott, E. A. See Elliott and Morley.

1906. Muir, F.—Notes on Some Fijian Insects. Hawaiian Sugar Pl. Assoc. Exp. Sta. Div. Ent. Bull. II, pp. 1-11.

1912. Müller, G. W. Der Enddarm einiger Insectenlarven als Bewegungsorgan. Zool. Jarhb. Jena, Suppl. 15, pt. 3, pp. 219-40.

1846. Mulsant, E. Coléoptères de France. Securipalpes.

1860. ———.—Note sur l'Harmonia (Coccinella) lyncea. Ann. Soc. Linn. Lyon. New ser. vol. 7, pp. 165-66.

1913. Oglobin, A.—Contribution á la biologie des Coccinelles. Rev. Russ. Ent., vol. 13, pp. 27-43, 10 figs.

1891. Olliff, A. S. Habits of Coccinellidae in Australia. Agr. Gaz. N. S. Wales. vol. 1, pp. 63-66, pl. 9.

1891. ———. The Leaf-Eating Lady Bird. Agric. Gaz. N. S. Wales, vol. 1, pp. 281-283.

1887. Ormerod, Eleanor A. Notes on the Australian Bug (Icerya purchasi) in South Africa, p. 31. London.

1862. Osten-Sacken, R.—Description of Some Larvae of North American Coleoptera. Proc. Ent. Soc. Phila., vol. 1, pp. 105-130.

1873. Packard, A. S.—Injurious and Beneficial Insects. Amer. Nat., vol. 7, pp. 524-48, fig. 151.

1880. ———. Guide to the Study of Insects. Ed. 7. New York.

1911. Palmer, Miriam A.—Some Notes on Heredity in the Coccinellid genus Adalia Mulsant. Ann. Ent. Soc. Amer., vol. 4, pp. 283-302, 4 pls.

1914. PALMER, MIRIAM A.—Some Notes on Life History of Ladybeetles. Ann. Ent. Soc. Amer., vol. 7, pp. 213–237, 2 pls.

1883. PERGANDE, TH.—Food Habits of Megilla maculata. Amer. Nat., vol. 17, pp. 322–23.

1893. PERRAUD, J.—Note on Coccinella septempunctata L. Bull. Soc. Ent. France, p. ccxxxviii.

1862. PERRIS, EDOUARD.—Histoire Des Insectes du Pin maritime Suppl. aux Coléoptères et Rectifications. Ann. Soc. Ent. France, ser. 4, vol. 2, pp. 173–243.

1838. PHILIPPI, R. A.—Ueber die Metamorphose der Coccinella globosa. Jahresber. d. Ver. f. Naturk Cassel, vol. 2, p. 11.

1898. PINNEY, W. H.—Voracity of Hippodamia glacialis. U. S. Dept. Agr. Ent. Bull., vol. 10 (new ser.), p. 99.

1902. PORTA, ANT.—Ricerche sull' apparatus di secrezione e sul secreto della Coccinella 7-punctata. Anat. Anz., vol. 22, pp. 173–199, pl. 7.

1880. PUTNAM, J. DUNCAN.—Biological and Other Notes on Coccidae. Proc. Davenport Acad. Nat. Sci., vol. 2, pp. 293–347.

1909. PUTZEYS, J.—Sur le Régime de la Larve de Coccinella hieroglyphica L. Ann. Soc. Ent. Belg., vol. 53, p. 95.

1907. QUAINTANCE, A. L.—The Aphides Affecting the Apple. U. S. Dept. Agr. Bur. Ent. Cir. 81, fig. 7.

1915. ————.—The San José Scale and its Control. Farmers' Bull. 650, U. S. Dept. Agr. Wash., 27 pp., 17 figs., 2 tables.

1886. RATHVON, S. S.—Northern Lady-Bird, Epilachna borealis. Gard. Month and Hort., vol. 28, pp. 372–73.

1839. RATZEBURG, J. C. T.—Die Forst-Insekten, Berlin, pt. 1.

1737. RÉAUMUR, R. A.—Histoire des vers Mangeurs de Pucerons. Mém. Hist. Insectes, vol. 3, mém. XI, pl. 3, figs. 20–27.

1871. REED, E. B.—New Enemies of the Colorado Potato Beetle. Can. Ent., vol. 3, pp. 163–70, fig. 35.

1809. REICH, D.—Bemerkungen über die Lebensverhältnisse der Coccinellen überhaupt und der Coccinella hieroglyphica Fabr. (flexuosa) insbesondere. Magaz d. Gesells. d. Naturf. Freunde zu Berlin, vol. 3, pp. 288–96.

1801. REUSS, I. D.—Repertorium Commentationum a Societatibus Litterariis Editarum, vol. 1. Gottingen.

1881–2. REY, C.—Note sur le Scymnus arcuatus Rossi. Ann. Soc. Linn. Lyon, pp. 131–33.

1883. ————.—Enumeration d'Insectes Remarqués sous Les Feuilles Malades du Tilleul. Ann. Soc. Linn. Lyon, pp. 440–442.

1886. ————.—Essai d'études sur certaines Larves de Coléoptères. Ann. Soc. Linn. Lyon, pp. 131–254.

1887.————.—Notes on Scymnus sp. Bull. Soc. Ent. France, p. lxxiv.

1904. RIBAGA, C.—Attivitá del Novius cardinalis Muls contra l' Icerya purchasi Mask. in Italia Osservazioni sulla Biologia del Novius cardinalis. Riv. Patol. Veg., vol. 10, pp. 299–323.

1915. RICHARDSON, C. H.—A Contribution to the Life-History of the Corn-Feeding Syrphus Fly (Mesogramma polita Say). Journ. Econ. Ent., vol. 8, pp. 338–42.

1869. RILEY, C. V.—Cherry Plant Lice and their Foes. Amer. Ent., vol. 2, p. 309, fig. 139.

1869. ————.—First Ann. Rept. Ins. of Missouri.

1872. ————.—4th Ann. Rept. Ins. Mo., pp. 17–18, fig. 4.

1872. ————.—5th Ann. Rept. Ins. Mo., p. 101, fig. —.

1873. ————.—Insects Injurious to the Grape Vine. 6th Rept. Ins. Mo., p. 30.

1873. ————.—6th Ann. Rept. Ins. Mo., p. 51.

866

1880. Riley, C. V.—The Cotton Worm. Bull. 3, U. S. Ent. Comm., p. 35, fig. 12.

1885. ———.—Fourth Rept. U. S. Ent. Commission, p. 96, fig. 15.

1888. ———.—A Lady-Bird Parasite. Ins. Life, vol. 1, pp. 101–04.

1889–90. ———.—Injurious Insects in New Mexico. Ins Life, vol. 2, pp. 113–114.

1893. ———.—Note on the Life Habits of Megilla maculata. Proc. Ent. Soc. Wash., vol. 2, pp. 168–169.

1893. ———.—Notes from California. Proc. Ent. Soc. Wash., vol. 3, pp. 250–54.

1894. ———.—The San José or Pernicious Scale. U. S. Dept. Agr. Rept. Ent., 1893, p. 220.

1888. ——— and Howard, L. O.—An African Lady-Bird Introduced into New Zealand. Ins. Life, vol. 1, p. 259.

1891. ——— and ———.—Some Icerya and Vedalia Notes. Ins. Life, vol. 3, pp. 439–441, fig. 31.

1894. ——— and ———.—The San José or Pernicious Scale. Ins. Life, vol. 6, p. 360.

1868–9. ——— and Walsh, B. D. See Walsh and Riley.

1907. Rivera, Manuel J. Desarrollo i Costumbres de Algunos Insectos de Chile. Act. Soc. Cient. Chile, vol. 50, 55 pp.

1874. Rogers, R. V.—On Some of Our Common Insects. 15.—The Coccinellidae. Can. Ent., vol. 6, pp. 81–85, figs. 9–15.

1749. Rösel, A. J.—Der runde, hoch-rothe Marien-Käfer mit schwarzen Puncten. Ins. Belust., vol. 2, cl. 3, p. 7, pl. 2, fig. 1.

1749. ———.—Der kleine schwarze Schildkäfer mit zween rothen Flecken. Ins. Belust., vol. 2, cl. 3, p. 10, pl. 3.

1882. Rosenhauer, W. G. Käfer-Larven. Stett. Ent. Zeit., vol. 43, p. 166–170.

1907. Rostrup, Sofie.—Vort Landbrugs Skadedyr. Copenhagen.

1858–9. Rouget, Aug.—Catalogue des Insectes Coléoptères du Department de la Cote-d'Or. Mem. Acad. Dijon, VII. Coccinellidae, p. 77–90.

1880. Rupertsberger, Mathias. Biologie der Käfer Europas.

1894. ———.—Die biologische Literatur über die Käfer Europa's von 1880 an.

1906. Sajo, Karl. Der Siebenpunkt. (Coccinella septempunctata.) Prometheus, vol. 17, pp. 489–92, fig. 391.

1863. Sanborn, Francis G. Insects of Massachusetts which are Beneficial to Agriculture. 10th Rept. Secr. Mass. Bd. Agr., 1862, pp. 124–185.

1905. Sanders, J. G.—The Cottony Maple Scale. U. S. Dept. Agr. Ent. Circular, vol. 64, pp. 1–6, 4 figs.

1912. Sanderson, E. D.—Insect Pests of Farm, Garden, and Orchards.

1883. Saunders, Wm.—Insects Injurious to Fruit. Philadelphia.

1884. ———.—Insects Injurious to the White Pine. Rept. Ent. Soc. Ont. for 1883, pp. 52–59, figs. 24, 25.

1907. Schaufuss, Camillo.—Allgemeines von der Käfer, Über die Lebensweise. Calwer's Käferbuch. pp. 25–26.

1894, '95, '97. Schlick, Will.—Biologiske Bidrag. Entomologiske Meddelelser, ser. 1, vols. 4, 5; ser. 2, vol. 1.

1890. Schwarz, E. A.—Myrmecophilous Coleoptera found in Temperate North America. Proc. Ent. Soc. Wash., vol. 1, pp. 237–47.

1894. ———.—The San José Scale, at Charlottesville, Va. Ins. Life, vol. 6, pp. 247–252.

1791. Scriba, Ludwig Gotlieb.—Fortsetzung der Beschreibung verschiedener Käfer. Ges. Naturf. Freunde in Berlin, Frankfort, vol. 8, pt. 2, pp. 80–109.

1868. Scudder, S. H.—An Insect Destructive to Squash Vines. Amer. Journ. Hort., vol. 3, pp. 80–82.

1891. ———.—The Early Stages of Three Coleoptera. Psyche, vol. 6, pp. 173–175.

1866. Shimer, Henry.—The Grape Leaf Gall-Coccus. Pract. Ent., vol. 2, pp. 17–20.

1870. Shimer, Henry.—Insects Injurious to the Potato. Amer. Nat., vol. 3, pp. 91–99.

1903. Silvestri, F.—Contribuzioni alla conoscenza dei Mirmecofili. Ann. Mus. Zool. Univ. Napoli, new ser., vol. 1, No. 13.

1910. ————.—Contribuzioni alla conoscenza degli insetti dannosi e dei loro simbionti. Boll. Lab. Zool. Portici, vol. 6, pp. 246–88, figs.

1914–15. ————.—Contributo alla consoscenza delgi insetti dell'olivo dell 'Eritrea e dell Africa meridionale. Boll. Lab. Zool. Portici, vol. 9, pp. 240–334, 78 figs.

1916. Simanton, F. L.—Hyperaspis binotata, A Predatory Enemy of the Serapin Scale, Journ. Agric. Res. Dept. Agric. Wash., vol. 6, pp. 197–203. Two plates.

1889. Slater, J. W.—Cannibalism with Lady-Birds. Ins. Life, vol. 2, p. 55.

1896. Slingerland, M. V.—The Pear Psylla and the New York Plum Scale. Cornell Univ. Agr. Exp. Sta. Bull. 108, pp. 77 and 85., fig. 45; fig. 47.

1886. Smith, J. B.—Ants' Nests and Their Inhabitants. Amer, Nat., vol. 20, pp. 679–87.

1893. ————.—Carnivorous and Herbivorous Insects. Ent. News, vol. 4, p. 123, figs. 1, 2.

1893. ————.—Insects Injurious to Cucurbs. Rept. Ent. Dept. N. J. Sta. Agr. Exp. Sta. 1892, pp. 475–512.

1893. ————.—The Squash Lady-Bird. Ent. News, vol. 4, pp. 197–199, 3 figs.

1894. ————.—Rept. Ent. Dept. N. J. Agr. Exp. Sta. for 1893, pp. 554–59, 5 figs. larvae.

1897. ————.—Natural Enemies of the San José Scale. Rept. Ent. Dept. N. J. Agr. Exp. Sta. 1896, pp. 517–530.

1904. ————.—Report of Entomological Department. N. J. Agr. Coll. Exp. Sta., 1903, pp. 555–659.

1909. ————.—The Insects of New Jersey. Rept N. J. Sta., Mus.

1870. Sommerville, J. E.—Note on Earlier Stages of Scotch Phytophaga. Ent. Month. Mag., pl. 7, p. 108.

1883. Stone, Geo. H.—Epilachna corrupta as an Injurious Insect. Amer. Nat., vol. 17, p. 198.

1788. Ström, H.—Nogle Insect-Larver med deres Farvandlinger. Norske Videnskabers Selsk. Skrift. N. Saml., vol. 2, art. XVII. Copenhagen.

1889–90. Taschenberg, O.—Bibliotheca Zoologica., vol. 2, 1861–1880. Leipzig.

1906. Theobald, Fred. V.—Report on Economic Entomology. Part 3, Vegetal Pests. 2nd Rept. Wellcome Res. Lab. Khartoum, pp. 93–96.

1894. Thompson, E. H.—Notes on Tasmanian Coccinellidae. Ins. Life, vol. 6, pp. 11–12.

1914. Trägårdh, Ivar.—Sveriges Skogsinsekter. Stockholm.

1890. Tryon, Henry.—Report on Insect and Fungus Pests. Ann. Rept. Dept. Agr. 1889, Brisbane.

1895. Verhoeff, C.—Beiträge zur vergleichenden Morphologie des Abdomens der Coccinelliden, und über die Hinterleibsmuskulatur von Coccinella, zugleich ein Versuch die Coccinelliden anatomisch zu begründen und natürlich zu gruppiren. Arch. Naturg., vol. 61, pp. 1–80, pls. 1–6.

1894. Vine, H. C. A.—Predaceous and Parasitic Enemies of the Aphides. Int. J. Micr., ser. 3, vol. 4, pp. 21–29; 166–175; 292–303; 337–51.

1865. Walsh, B. D.—Answers to Correspondents. Pract. Ent., vol. 1, p. iii.

1867. ————.—Plant-lice, their Friends and their Enemies. Pract. Ent., vol. 2, pp. 37–44., figures.

1868. ———— and Riley, C. V.—Foes of the Colorado Potato-Bug. Amer Ent., vol. 1, pp. 45–49.

1869. ———— and ————.—Galls and Their Architects. Amer. Ent., vol. 1, pp. 101–110.

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1894. Wasmann, E.—Kritisches Verzeichniss der Myrmekophilen und Termitophilen Arthropoden. Berlin.

1888. Webster, F. M.—Notes on Some Injurious and Beneficial Insects of Australia and Tasmania. Ins. Life, vol. 1, p. 361-64.

1890. ———. An Experiment with Coccinellidae in the Conservatory. Ins. Life, vol. 2, p. 363-4.

1889. Weed, Clarence M.—On the Preparatory Stages of the 20-spotted Lady-Bird (Psyllobora 20-maculata Say.). Bull. Ohio. Agr. Exp. Sta. Techn. Ser., vol. 1, No. 1, pp. 3-4, pl. 1, fig. 1.

1887. Weise, J.—Ueber die Lebensweise von *Novius cruentatus* Muls. Deutsch. Ent. zeitschr., vol. 31, pp. 181-83.

1902. ———. Biologische Mittheilungen. Deutsch. Ent. Zeitschr. pp. 103-109.

1903. ———. Bemerkungen über die ersten Entwicklungsstadien der Coccinella conglobata L. Deutsch Ent. Zeitschr., pp. 161-166.

1862. West, Tuffen.—The Foot of the Fly; Its Structure and Action: elucidated by Comparison with the Feet of Other Insects. Trans. Linn. Soc. Lond., vol. 23, pp. 393-421, 2 pls.

1839. Westwood, J. O.—Introd. Mod. Classif. Ins. Coccinellidae, pp. 395-398, fig. 49.

1911. Wheeler, William Morton.—An Ant-Nest Coccinellid (Brachyacantha quadripunctata Mels.). Journ. N. Y. Ent. Soc., vol. 19, pp. 169-174, fig. 1.

1894. Wickham, H. F.—The Coleoptera of Canada. Can. Ent., vol. 26, pp. 297-306, 18 figs.

1890. Wight, R. A.—The Australian Ladybird in New Zealand. Ins. Life, vol. 2, pp. 146-7.

1892. ———. Vedalia and Icerya in New Zealand. Ins. Life, vol. 4, pp. 215-216.

1879. Williams, Jos.—Beneficial Insects. 9th Rept. Ent. Soc. Ont., pp. 43-45, fig. 28-35.

1895. Xambeu.—Moeurs et Métamorphoses des insectes. Ann. Soc. Linn. Lyon, vol. 42, p. 101.

1905. ———. Moeurs et Métamorphoses des Insectes. Ann. Soc. Linn. Lyon, vol. 52, pp. 137-187.

1909. ———. Moeurs et Métamorphoses des Insectes. Ann. Soc. Linn. Lyon, vol. 56, pp. 1-47.

1910. ———. Moeurs et Métamorphoses des Insectes. Ann. Soc. Linn. Lyon, vol. 56, pp. 1-47.

## EXPLANATION OF PLATES.

*a*........Antennal ring.
*abd*.....Abdominal segment.
*al*.......Alar area.
*an*......Anterior cuneal notch.
*apc*.....Apex of the mandibles.
*arst*.....Armlike extension from eusternum.
*bg*......Repugnatorial gland.
*bm*......Basal membrane of the mandible.
*br*......Hypopharyngeal bridge.
*c*.......Clypeus (= postlabrum Lyonet).
*ca*......Cardo.
*ccx*.....Chitinization with which coxa articulates.
*cm*......Articulating membrane between cardo and hypostoma.
*cols*.....Seta emitted from a collar-like prolongation of the head cup.
*cox*.....Coxa.
*ec*......Epicranium.

| | |
|---|---|
| *ep* | Epistoma. |
| *eph* | Epipharynx. |
| *er* | Epipharyngeal rod. |
| *eust* | Eusternum. |
| *ex* | Place where extensor muscle of mandible attaches. |
| *ext* | Spiracle-bearing extension from tergum. |
| *f* | Frons. |
| *fe* | Femur. |
| *fil* | Filament at the apex of the second antennal joint. |
| *fl* | Place where flexor muscle of mandible attaches. |
| *fn* | Furcal notch. |
| *g* | Rudimentary galea. |
| *gu* | Gular region. |
| *h* | Hypostoma. |
| *hr* | Hypopharyngeal rod. |
| *htri* | Triangular enlargement of hypostoma. |
| *hy* | Hypopharynx. |
| *l* | Stipes labii. |
| *la* | Lacinia maxillaris. |
| *li* | Ligula. |
| *lo* | Chitinous plate in membrane between cardo and hypostoma. |
| *lp* | Labial palpus. |
| *lr* | Labrum. |
| *m* | Mentum. |
| *md* | Mandibles. |
| *mea* | Median ventral area of the collar between head and prothorax. |
| *mo* | Molar portion of the mandible. |
| *ms* | Small chitinous spots indicating muscle attachments. |
| *oc* | Ocellus. |
| *pasc* | Parascutum. |
| *past* | Parasternum. |
| *pcx* | Hypopleurum. |
| *pgc* | Chitinized portion of palpiger. |
| *ph* | Pharynx. |
| *plg* | Palpiger maxillae. |
| *pll* | Pleural lobe. |
| *pn* | Posterior cuneal notch. |
| *por* | Pore in the skin. |
| *prst* | Presternum. |
| *psc* | Prescutum. |
| *rlm* | Retinaculum. |
| *sc I* | Anterior portion of scutum. |
| *sc II* | Posterior portion of scutum. |
| *scl* | Scutellum. |
| *se* | Sensory papillae of the apical joint of the maxillary palpus. |
| *sm* | Submentum. |
| *sp* | Spiracle. |
| *spa* | Spiracular area. |
| *st* | Stipes. |
| *std I* | Distal portion of the dorsal surface of stipes maxillaris. |
| *std II* | Basal portion of the dorsal surface of stipes maxillaris. |
| *stl* | Sternellum. |
| *stm* | Membrane of the distal end of stipes. |
| *stp* | Sternopleural or sublateral suture. |

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*str*.......Rod-like chitinization of the interior margin of stipes maxillaris.
*ta*.......Paired ventral area of the collar between head and prothorax.
*tars*.....Tarsus.
*tds*......Transverse dorsal suture.
*tib*......Tibia.
*tp*.......Tergopleural or lateral suture.
*tro*......Trochanter.
*vn*.......Ventral notch.
*vps*.....Vertical suture between the posterior pleural areas of one segment and the adjacent pleural areas of the following segment.
*1*.......Protopleurite.
*2*.......Deuteropleurite.
*3*.......Tritopleurite.
*4*.......Tetrapleurite.

### PLATE 118.

*Hyperaspis binotata* Say.

FIG. 1.[1] Full grown larva; lateral view; nat. length, 2.5 — 6.25 mm.
2. Full grown larva, dorsal view.
3. Full grown larva, ventral view.
4. Anterior portion of the dorsal half of the cranium; from the inner side.
5. Portion of the skin.
6. Right mandible, dorsal view.

### PLATE 119.

FIG. 7. Mouth cavity and the anterior, ventral portion of the pharynx (slightly diagrammatically).
8. Head, dorsal view; the mandible and the hypopharyngeal bridge, below the labrum, are indicated by a striated shadow on the labrum; the joints of the antennæ are marked I, II, III.
9. Head, half dorsal, half front view; mandible and hypopharyngeal bridge below the labrum indicated by a striated shadow on the labrum.
10. Head, ventral view.

### PLATE 120.

FIG. 11. *Thalassa montezumae* Mulsant, lateral view of meso and metathorax, first and second abdominal segments.
12. *Rhyzobius ventralis* Erichson, lateral view of meso and metathorax and first abdominal segment.
13. *Coccinella 7-punctata* Linnaeus, lateral view of meso and metathorax and first abdominal segment.
14. *Chilocorus bivulnerus* Mulsant, lateral view of meso and metathorax, first and second abdominal segments.
15. *Hippodamia convergens* Guérin, hypopharyngeal bridge, seen from above.
16. *Epilachna borealis* Fabricius, hypopharyngeal bridge, seen from above.
17. *Microweisea coccidivora* Ashmead, right mandible, dorsal view.
18. *Azya* sp., right mandible, dorsal view.
19. *Harmonia picta* Randall, right mandible, dorsal view.
20. *Psyllobora parvinotata* Casey, right mandible, dorsal view.
21. *Epilachna borealis* Fabricius, right mandible, dorsal view.

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[1] I am indebted to Miss E. Hart, who has executed the final copy of figs. 1–10.

PLATE 121.

FIG. 22*a*. *Microweisea ovalis* LeConte, dorsal view of head.
22*b*. *Microweisea ovalis* LeConte, dorsal view of larva; length about 2 mm.
23. *Stethorus punctum* LeConte, dorsal view of head; length of entire larva about 2 mm.
24. *Cephaloscymnus* (?), dorsal view of larva; length, about 2½ mm.
25*a* *Scymnus coniferarum* Crotch, dorsal view of head.
25*b*. *Scymnus coniferarum* Crotch, dorsal view of larva; length about 5 mm.
26. *Scymnus cervicalis* Mulsant, dorsal view of larva; length about 3 mm.
27. *Novius cardinalis* Mulsant, dorsal view of larva; length about 4½ mm.
28. *Micraspis* 12-punctata Linnaeus, dorsal view of larva; length about 4½ mm.
29. *Neda marginata* Linnaeus, dorsal view of larva; length about 11 mm.
30. *Psyllobora parvinotata* Casey, dorsal view of larva; length about 3½ mm.
31*a*. *Epilachna borealis* Fabricius, dorsal view of head.
31*b*. *Epilachna borealis* Fabricius, dorsal view of larva; length about 10 mm.
32*a*. *Lindorus lophantae* Blaisdell, dorsal view of head.
32*b*. *Lindorus lophantae* Blaisdell, dorsal view of larva; length about 3½ mm.
33*a*. *Exochomus cubensis* Dimmock, dorsal view of head.
33*b*. *Exochomus cubensis* Dimmock, dorsal view of larva; length 6 mm.
34. *Orcus australasiae* Boisduval, dorsal view of the right side of thorax; length of the entire larva about 6 mm.
35*a*. *Chilocorus bivulnerus* Mulsant, dorsal view of head.
35*b*. *Chilocorus bivulnerus* Mulsant, dorsal view of the right side of thorax; length of entire larva about 8 mm.

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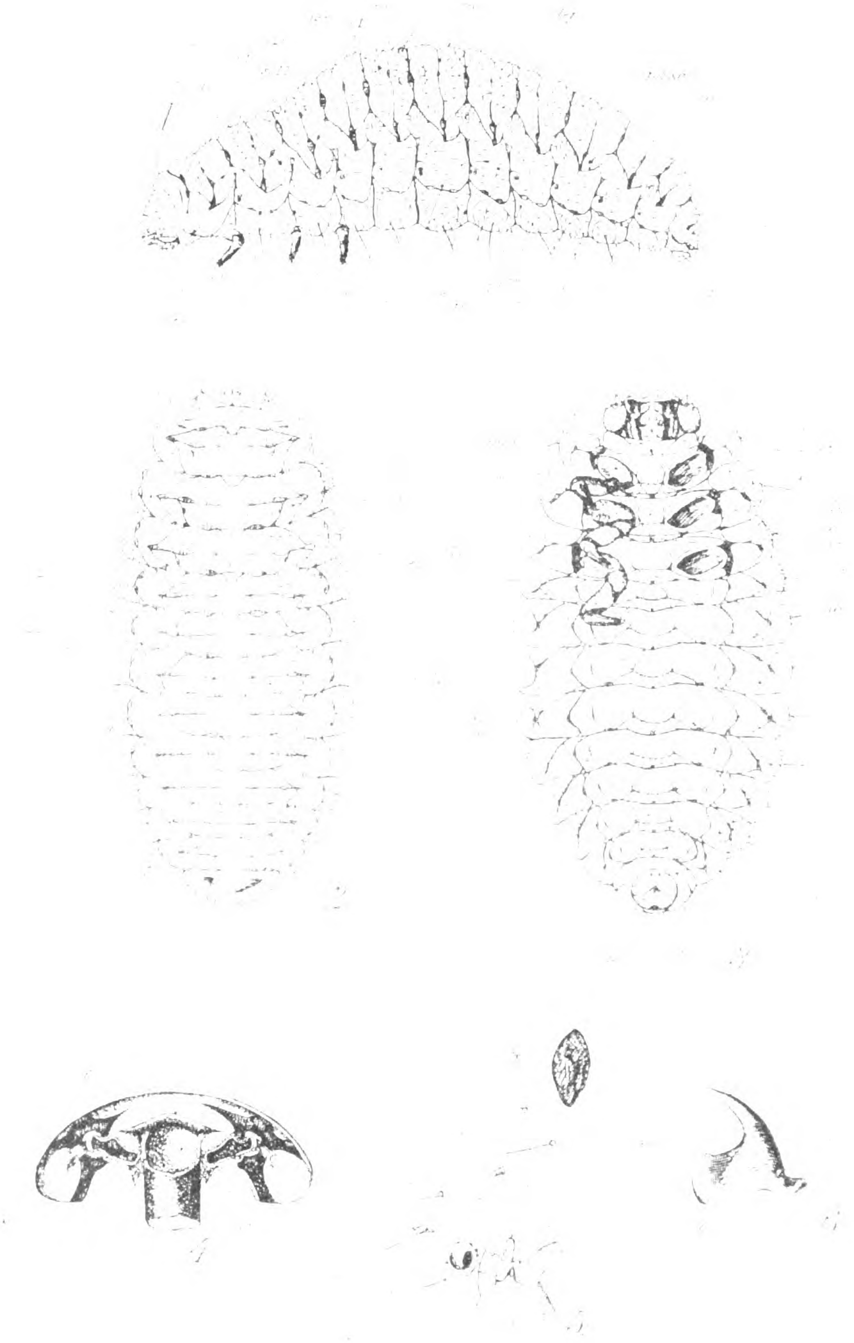
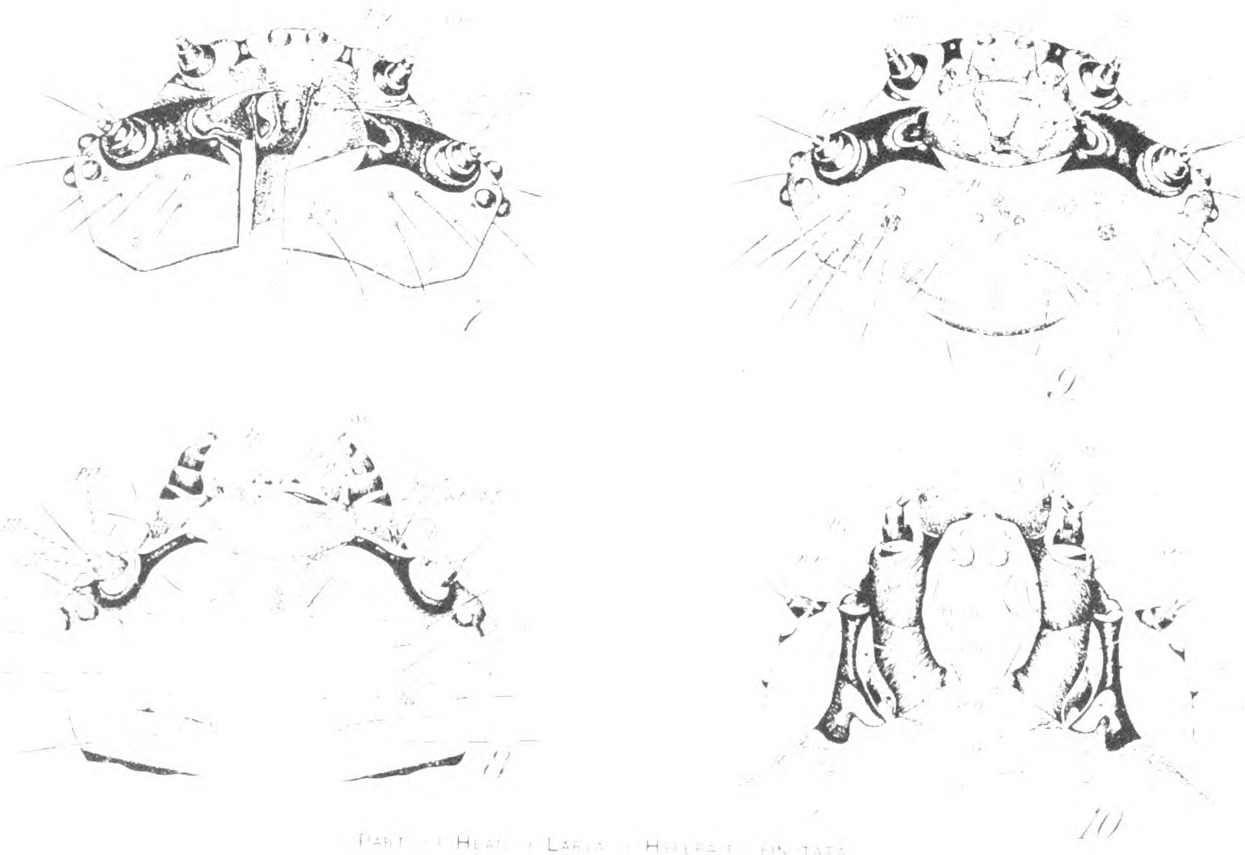


LARVA OF HALIPLUS [illegible]



PARTS OF HEADS OF LARVÆ OF H[illegible] [illegible]TATA

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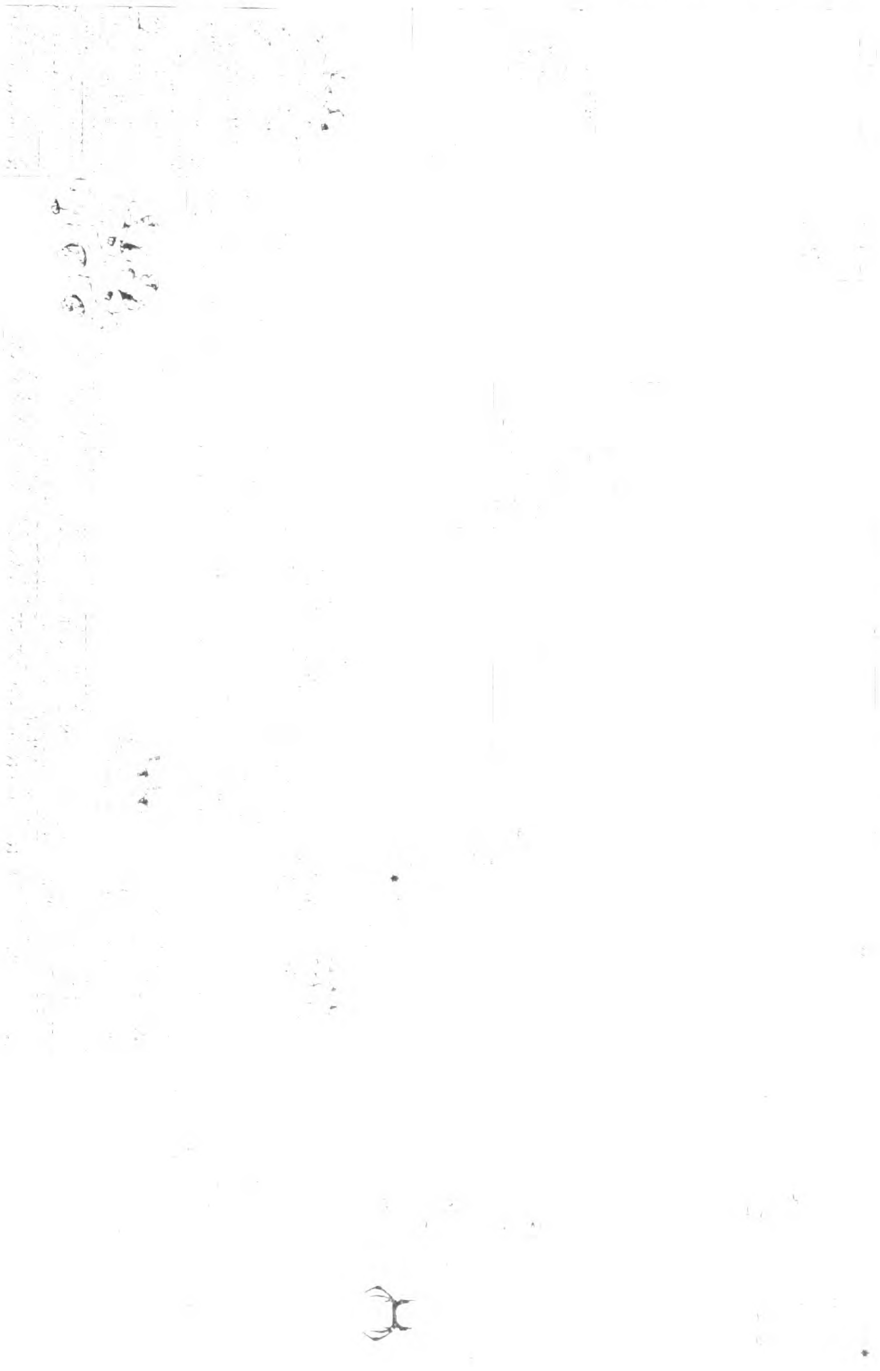

SYNOPSIS OF THE LARVAE OF THE COCCINELLIDAE.

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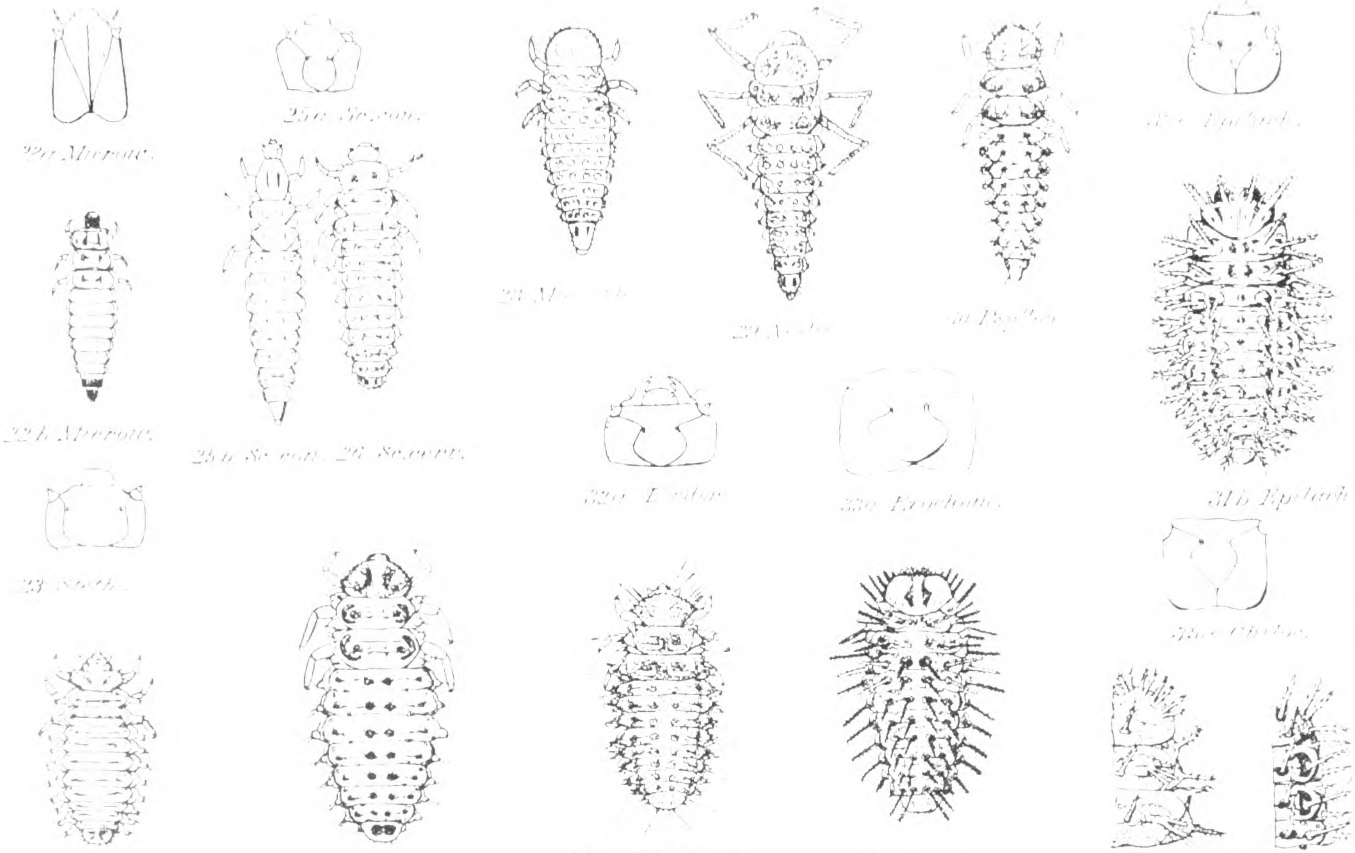
22a Microw.
25a Scymn.
28 M[illegible]
29 Ad[illegible]
30 Psyllob.
31a Epilach.
22b Microw.
25b Scymn. 26 Scymn.
31b Epilach.
32a Lindor.
33a Exochom.
23 Steth.
35a Chiloc.
24 Cephalosc.
27 Novius
32b Lindorus
33b Exochom.
34 Orcus
35b Chiloc.

TYPES OF THE LARVAE OF COCCINELLIDAE.

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